

HABITS OF
CALIFORNIA PLANTS

CHANDLER



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HABITS
OF
CALIFORNIA PLANTS

BY
KATHERINE CHANDLER

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To My Mother,
Whose Love for the Wildlings of Nature
Has made them Sentient Individuals
To Her Children.

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PREFACE.

The subject matter of this book appeared first as a series of papers on California Wild Flowers on the Children's Page of the San Francisco *Chronicle*. Upon publication, requests came from school teachers in different parts of the state to issue the series in book form. This is the excuse for the book's existence.

The plants are introduced through their blossoms, because the flower is the part that appeals to the child, except in the case of trees; but it is hoped that the suggestions as to the habits of the roots, stems, and leaves will be emphasized by the teacher. When the child gains the feeling that each plant is really an individual, with its own peculiar way of doing its life work, the whole out-of-door world becomes a larger, more wonderful realm.

The habits of plants was first suggested to the writer by Miss Alice Eastwood, Botanist of the California Academy of Science, in a class connected with her department. To her is due much that is of value in the work. My mother suggested the writing of the papers for the *Chronicle* and collected many of the specimens for the illustrations. Professor W. A. Setchell and Professor W. L. Jepson of the Department of Botany of the University of California rendered assistance in the study of trees. Professor Jepson loaned some of his photographs and Mr. H. M. Hall, also of the Department of Botany, University of California, secured specimens for the photographs. Mrs. Alice Merritt

Davidson's "California Plants in Their Homes" and Miss Mary Elizabeth Parsons' "The Wild Flowers of California," as well as the best known botanies of the Coast, were consulted frequently in the preparation of the papers.

I am also indebted to Miss Bertha Chapman, Supervisor of Nature Study in the Oakland schools, for trying the manuscript in the different grades, to Mr. B. F. White of the University of California, for his patience and skill in photographing the specimens, and to Miss Harriet Hawley of New York, Miss Marion Rouse of Pacific Grove, and my brother, A. E. Chandler for encouragement and helpful criticism.

San Francisco, Cal.,

Oct. 15, 1903.

KATHERINE CHANDLER.

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BUTTERCUP.

CHAPTER I.

SOME PLANTS WITH GAY COROLLAS.

Most of you boys and girls will agree that one of your earliest acquaintances among the wild flowers was the Buttercup. Its golden **BUTTERCUPS.** smile attracted your baby eyes, and when some older person held it under your chin to see if you "loved butter," you immediately fell in love with the wise little blossom. Since then you have seen so many Buttercups that perhaps you accept them with the same indifference that you do the sunshine, and have learned very little of their interesting habits.

You know you would never really feel acquainted with Johnny Jones or Ruth Gray if you simply glanced at their pretty clothes and never saw them working or playing. It is the same with the flowers. If you do not know what they *do*, you really are not acquainted

with them. Suppose you watch a Buttercup carefully and see which of its habits you have already observed and which are new to you.

Each one of you has noticed that the upper side of the Buttercup petal shines as if varnished and that the lower side is a dull, lighter color. Have you all found a little heavy plate applied at the lower end of the upper face of each petal and the dainty fine lines leading down to this plate? Just look for them. The plate is a dish of honey and the lines are called "honey paths" because they guide the hungry insect down to the feast set for him. The Buttercup's "golden chalice" attracts the insect. He approaches it and smells the honey. Then he lands on one of the honey paths and soon is devouring the sweetness. While he satisfies his hunger, he rubs against the outside stamens and gets all powdered with the yellow pollen from their anthers. When he has taken the honey from one Buttercup, he goes to another; and in extracting its sweets, he is most likely to brush his powdered sides against the stigma, which quickly holds the pollen fast. This

stigma, you know, is the top of the pistil, wherein little cells are waiting for some pollen to make them grow into seeds.

This is why the Buttercup wears such a pretty golden gown and stores such luscious honey — just to make the insect exchange her pollen with that of a sister blossom. This is the way the Buttercup ripens good seeds to produce healthy plants the next year.

If, through some mischance, an insect does not bring pollen to a blossom, it can fertilize itself. When the outside anthers, which turn away from the center, discharge all their pollen, the inner ones ripen and some of their pollen falls on the stigma of their own flower. Just watch how the different circles of stamens ripen in turn.

Because the seed-making parts of the flower are the most important, the rest of the blossom is very careful of them. You have seen how, as soon as the sun goes behind the hills, the Buttercup folds its petals close under its fur-covered green sepal coats. Then it sleeps snugly until the next sun awakens it. Do the

old blossoms that have their seeds started also fold their petals?

Have you noticed the cone-shaped bundle of seeds and the little hook on the end of each seed? When the seed is quite ripe, it fastens this hook into anything passing by—perhaps the coat of a sheep, perhaps the nap of your clothing—and then it is carried to a new field.

The Californian Indians used to parch this seed cone of the buttercup and beat it into a meal. Sometimes this was eaten in the dry, powdered form and sometimes as a gruel, made by dropping hot stones into a grass basket of water until the water was hot and then mixing in the meal. It is said to have tasted like parched corn. You might try it for a dolls' party.

Another golden flower that springs up just after the early rains is what is commonly called

MUSTARD. Children who have been compelled to pull it up from their fathers' orchards or grain fields grow to detest it, and yet it is beautiful to look at. When millions of the dainty blossoms glow on hillside

or in valley, California is a "Golden State" indeed.

This pretty flower is not really a Mustard, but a wild turnip, as you will see if you dig up its root. The true Mustard, "the black Mustard," which blooms somewhat later, is not a native Californian, though it has played a part in the history of our state. Over a hundred years ago, when the Spanish padres were founding missions here and there in the wilderness, they scattered Mustard seeds along their footsteps from one site to another. The Mustard grew fast and kept a well defined path in sight. In these days of improved roads, it needs no longer be a sentinel, so it wanders with the wind to every nook and corner of the country. The early settlers at San Jose found the Mustard plant so tall that they used it to make their first sheds and chicken-houses. From the seed of this Mustard, a superior medicinal oil is made, and hundreds of tons of the seeds are shipped from California each year.

Of course, the Mustard has no intention of being useful to man. It only wishes to ripen



WILD MUSTARD.

strong seeds and to scatter them over the earth; so it wears the bright-hued dress and spreads out the feast of honey, just as the Buttercup does. Find the honey glands yourself. They are not on the petals, but you can easily find them. If you drink the drops of fragrant nectar, you will approve of the insect's seeking it. The Mustard produces thousands of seeds and holds their cases high up in the air so that the wind may carry the ripened seeds broadcast over the land.

Many of the early flowers are cousins to the Mustard. Their family name is *Cruciferae*, because their four petals are arranged as a cross. *Cruciferae* is not a hard name to remember, when you once know what it means. And just here, I wish to say to you boys and girls that very few of the botanical names *are* hard to remember after you get them connected with the plants they belong to. They are no more difficult than "photograph" or "automobile," that you know so well. If a boy named Tadeusz Kosciusko sat next you in school, in a few days his name would seem as easy to you



SHEPHERD'S PURSE.

as John Smith. So you will find it with plants, if you try to remember the botanical titles.

But to go back to the *Cruciferae*, you will find that they all have six stamens, two shorter than the others. The Spring Beauty, the Shepherd's Purse, the Pepper Grass, the Turnip, the Lace Pod, the Wall Flower, and the Rock Cress are members of this family, and you will find other common ones if you are observing. Be sure to notice their seed-cases. They are interesting.

A common yellow flower that you might mistake for a *Cruciferae* because of the arrangement of its four petals is the Suncup or Cowslip.

It blooms close to the ground out of **SUNCUP.** a mat of green leaves. If you examine it, you will find it has eight stamens instead



SUN CUP.

of six. It really belongs to the Evening Primrose family, the *Onagraceæ*. Just notice its calyx. See how it lengthens out into a tube and goes down, down under the dark earth until it ends in the ovary or seed vessel. Think of such a sunny flower ripening its seeds beneath the ground! How do you suppose it scatters its seeds? See if you can find out. Why do you think the Suncup hides her seeds so securely?

Is there one of you children who has not hailed with delight the first Baby-blue-eyes you met in the spring? And have you ever grown **BABY-BLUE-EYES.** tired of the dainty little blossoms, even when the fields were blue with them? In spite of the fact that this flower looks as delicate and as helpless as a baby, it is very well able to take care of itself. You will find on its petals honey paths and hairy little bowls of nectar.

Then investigate to learn why Baby-blue-eyes is so generous. Look at her five stamens and notice the brown anther at the top of each. See how in the fresh blossom it tilts outward



BABY-BLUE-EYES.

toward the petal. When the bee comes down the honey path, he bungles around and hits the stamen. Then the anther opens and lets some of the gray pollen fall upon him. When he has eaten all the honey in one flower, he flies to another Baby-blue-eyes. While he is wandering head downward in it, his sides and legs are sure to brush the two little stigmas at the top of the pistil, and leave some pollen upon them. If no insect brings Baby-blue-eyes pollen, as she grows old, she turns her anthers in and pours their pollen upon her own stigmas.

Some people call the Baby-blue-eyes the Californian Bluebell, and the Spanish Californians named it Mariana, in honor of the Virgin Mary. Its botanical name is *Nemophila insignis*. *Nemophila* means "lover of the grove," and is better applied to other members of the family than to our Baby-blue-eyes, who revels in the sunshine. *Insignis* means "remarkable" or "marked," and is probably given because of the clearness of the color.

A sister of Baby-blue-eyes, a violet *Nemophila* that lives in woodsy spots, has a habit dif-

ferent from the rest of its family. When you pick it, you find the stems all prickly and at the same time so weak that they break at your touch. If you look at the stem under a microscope, you will see that each prickle is a tiny hook, ready to catch on to anything that offers support and also ready to pierce any mouth that may wish to devour it. They say that the Spanish Californian señoritas used to decorate their party dresses with this *Nemophila* because it clings so gracefully. Probably no girl used it the second time, for it wilts so quickly it would look pretty only a few moments.

Our State Legislature in 1903 adopted as our State flower, the Poppy, and we will all agree that no other blossom is so suggestive **POPPY**. of our golden-hearted California. You know why the Poppy wears so gorgeous a dress. Have you ever found an insect wandering round in one? Why was it there? The Poppy does not spread a feast of honey, but she keeps a large supply of pollen for the bugs, and while they eat it, she sifts some over them. You have all powdered your nose with the Poppy's



POPPY.

gold, but have you watched how the anther discharges this rich dust?

You know the pale green night cap that the Poppy bud wears and you have seen the bud push it off. Have you noticed how as the flower grows old each petal curls up by itself around its own pollen boxes? The Poppy is so careful to keep her pollen dry that she keeps open house only in the sunny midday.

Did you ever pull off a Poppy petal? If so, what else did you get, and what was the shape of the lower part of the petal? Why is it so? Do you know how the seed-case is arranged and what will make it open? Watch it. Does the root of the Poppy die when the leaves fade? See for yourself.

If you care to read about flowers, you will find that the Poppy has been more sung about than any other of our California wild flowers. All visitors have been impressed with its beauty. Indeed its botanical name tells of a visitor from Germany. Early in the last century a Russian ship, which was going around the world, stopped at California. On board

was a botanist who named all the native flowers new to the scientific world. On board was also a physician named Dr. Eschscholtz. As he admired the Poppy very much, the botanist named it *Eschscholtzia*, for him, and *Californica* for its birthplace.

In the East and in Europe the Poppy is a treasured garden plant. However it grows paler under civilization, and only here on our own shores, where it wanders entirely free, has it the warm hue of blazing flames.

If you had been born a little Indian in Placer County fifty years ago, you would have eaten the Poppy plant as a green after your mamma had boiled it or roasted it on hot rocks. If you had lived here in the Spanish Californian days, you might have used an oil made from the Poppy fried in olive oil to make your hair long and glossy. Today the druggists find the plant useful. They use its extract as a cure for sleeplessness and headache. If you spend some time each day out studying the Poppy's habits, you will never have a headache nor need a sleeping cup.

One of the gayest robed of our early flowers is the Shooting Star. You know how the stalk comes up from the lowly mat of gray green leaves and is crowned with **SHOOTING STAR.** a cluster of radiant blossoms. How gracefully the petals of each flower curve back their crimson folds! See how their front forms a tube edged with bands of maroon and yellow or white. Notice the tube-like arrangement of the dark anthers and how the long pistil extends out beyond them.

All the flowers of the cluster do not bloom at once, so that sometimes the stalk waves its banner for several weeks. The Shooting Star has a reason for this and for her clustered blossoms. She does not store honey and so she has to depend on her beauty for attention from the insects. She raises her stalk far above her leaves so as to have a prominent position; she sends out a group of blossoms so as to make a larger mass of color; and she has them ripen by stages so that they will have more time to receive insect visitors. If they died in a day, as some



SHOOTING STAR.

blossoms do, she would never receive pollen from a sister plant.

Shooting Star is careful of her pollen. The anthers hold it fast until something shakes them. If no insect comes, when the flower grows old the stigma turns up a little; and, as the wind shakes the stalk, the pollen falls out of the anthers upon it and the seed is ripened.

Have you noticed the little stems that hold the flowers at the top of the stalk? See how they stand up straight when they bear a bud, curve over when it is a blossom to protect the pollen, and then become erect again when they are holding the seed-case. How does this seed-case open to let the seeds out, and just what will make it open?

Did you ever dig up a Shooting Star and look at its roots? If you transplant any one of the tubers, you may have a new plant from it. You will see that this habit of the roots is a good way to multiply the Shooting Star. Do you know any other plant that has roots with this habit?

I wonder what you call the Shooting Star?



HOLLYHOCK.

Some children call it "roosters," some "mosquito bill," and others "prairie pointers." The botanical name, *Dodecatheon* means "twelve gods." Probably some old Greek found twelve blossoms in a cluster and gave it this name. Have you ever found so many on one stalk? I have not.

When you see in the early spring a pink glow in some uncultivated field or on some sunny hillside, you know that the wild Hollyhock has awakened to her year's work. You

HOLLYHOCK. pick a stem with its dainty bell-shaped blossoms all crowded to its top, and as you gaze into one blossom of gauzy rose-pink heavily veined with white, you exclaim, "Miss Hollyhock, too, must be expecting guests." You raise it nearer to your nose and get a whiff of nectar sweeter and more delicate than even that of Baby-blue-eyes. Then you search for the honey glands, and find also the "honey protectors," the little hairs that keep the moisture out.

As you look into the center of the flower, you may see one of two things. The long, thin

rose-colored styles of the pistil may be standing up straight from a vase-like column of stamens, the heads of the pistil quite high above the white anther fringe at the stamen tops. The blossom that has this arrangement is generally deeply tinted with rose.

Now look into a paler flower. There is just a beautiful bouquet of dust-covered anthers at the top of the stamen column, and no pistil in sight. See how much fuller and prettier these anthers are than the ones in the blossom with the pistil. Now you must examine to see where the pistil of this flower is.

If you take a fine pointed pin and open the stamen tube, you will find the red lines of the pistil pushing up inside. If you find an older pale pink blossom in which the anthers have already cast out their creamy powder, you may find the pistil towering higher than the stamens. Notice a number of the lighter flowers, and after a time you will see that their pistils do not grow up ready to form seed until their anthers have thrown away all their pollen. So the Hollyhoek, with its two seed-making parts

ready to work at different times, would have no seed at all, if the insects did not carry the dust from one blossom to the waiting pistil in another.

If you look again at the dark rose flowers you will see that in even the newest buds, the pistils shoot above the stamens, and that the anthers are always tiny things. The fact is that the anthers of these darker flowers do not produce a pollen for seed, and the pistil has to depend upon the bugs for its supply. This pollen must, of course, come from the paler flowers. So you see they furnish all pollen for both colored blossoms. Have you noticed that these fairer bells are larger than the darker ones? Do you think their size means anything? See if you can tell if there is a difference in the amount of honey in the two colors. Sometimes I think one is sweeter than the other; but I am not sure, so I will not tell you which.

If you wish to see the difference between the anthers of the dark and the pale flowers, open two buds. See how in the light blossoms the rich-colored anthers crowd the space, each one kidney-shaped on the top of a tiny stem. See

that in the darker flower the anthers are pale and weak. In both flowers, however, you will find the stamens united into a tube around the pistil. If you examine this carefully, you will find the tube a double one. The outside layer has its anthers grouped into five sets about opposite the petals, while the inner one has its anthers set regularly along its top.

In the bud, too, you can see how the sepals fold together and how they wear a furry outside coat. Look at their inner lining. Also notice how they cling on around the growing seed after the petals have first changed their pink gowns for the half-mourning violet and then have fallen away.

Observe the green leaves of the plant. See how the ones at the bottom of the stem are not cut so deep as those at the top. If you spread one of each kind out flat, you will see that they are really the same shape. Can you tell why they should be cut differently? Are these two kinds of leaves equally hairy? Are the hairs the same on the upper and lower faces? Are these faces the same color? Have the leaves

near the flowers as long stems as the ones lower on the stem?

When you look at the seed-case of the Hollyhock, with its cells arranged like the sections of an orange, you are reminded of the "cheeses" of that garden pest, the Mallow. In fact, the Hollyhock and the Mallow are own sisters, both members of the *Malva* family.

Do children to-day eat "cheeses"? When I was a child, these seed-cases formed several dishes for our dolls' parties. They are so dented for cutting that they seem made on purpose for little people's pies. My heart was always divided regarding this plant. I was grateful for its cheeses, but I did hate to have **MALLOW** to be continually weeding it from the garden. If you count the number of seeds in each "cheese," and then notice the number of "cheeses" on each plant, you will see how the number of weeds is possible. Learn how the seed-case divides and sends out its seeds.

The Mallow's flower you can study for yourself and see wherein it is like the Hollyhock; but the leaves have a habit I would like to call



MALLOW.

your attention to. Notice how they always face the sun. Look at one plant in the morning, then at noon, and again at night. See how the leaf stems are of different lengths, so that no two leaves interfere with each other's warmth. Take a handful of leaves, and hold them against your face. Do you find them colder than other leaves? Notice the thickness and the covering of the leaves, and see if these have anything to do with their seeking the sun.

Then examine the leaf stem. See how it is rounded except on the side nearest the main stalk. There it is flat, so as to give the new leaves a chance to grow out from where it joins the stalk. Notice that at every one of these joinings or axils there is a new branch pushing out. It is interesting to watch the leaves develop from the tiny folded fan to the great round shield. By the way, those children who are used to weeding the garden know that the first two leaves the Mallow sends overground are a very different shape from any of her others. Suppose you all learn the difference.

In studying plants, you must pay attention

to the habits of the leaves and stems and roots as well as to those of the parts of the flower. You know that your mind can work the hard examples best when all your body is perfectly well, when you are free from cold or toothache or any other pain. And so the plant, too, can do its work best—can produce the best seed—when all its parts are working healthfully together. As Lillie does not study her geography in the same way Bert does, so the plants vary in the ways they divide their roots or build up their stems or shape and carry their leaves.

Watch the leaves and see how they hold themselves, side up to the sun or edge up, point up or sidewise or down. Notice if their position is the same at all times of the day. See the ones that "go to sleep," and learn if they take their nap at night, like you, or at noon. However they stand or whatever they do, you will find some reason for it. As you hunt up these reasons, you will come to feel that a plant is a very intelligent creature in its own business of seed-making.

CHAPTER II.

SOME PLANTS WITH ATTRACTIVE CALYXES.

A long time ago, children, you looked at a flower and some one told you that the bright colored part was called the corolla. At the same time you received the idea that the calyx was always green. In many of the blossoms you have examined, you have found this true, and you have supposed it always is so. Let us see if it is.

Take an Iris or Flag Lily. You know well its rich coloring and its graceful form. If you look at a full grown blossom, you see nine bright parts, all of which seem to be petals.

IRIS. There is no sign of a green calyx, such as Baby-blue-eyes wears all her life and Poppy pushes off when she greets the sun; there does not seem to be any pistil; and, at first sight, you do not see any stamens. Why, what an odd flower this is! How is it ever going to make its seeds?



IRIS.

In the first place, we must know that sometimes the calyx of a flower is not green. Now, look at the Iris again. Those three large parts that are outside and are the most beautifully colored and marked are really the calyx. The Iris is a great lover of beauty and so centuries ago she developed these gorgeous sepals from the plain green ones, just as women to-day wear more beautiful gowns than the first women of the world did. The next three parts of the Iris, the ones that first stand straight and then curve inward, are the petals. You see they are not so exquisitely marked as are the sepals. They do not need to be, as the sepals do their work. The three inner parts that curve first outward and then toward the center are the three stigmas. Just compare them with the two little round black stigmas that Baby-blue-eyes carries, and see how much more beautiful they are. Notice how the stigma divides into two parts at the top, just before it takes the inward curve. See the little light-colored shelf on the outside, just below this division. When you have found that, you have also found the stamen, which

curves along the stigma's back and which is attached at the bottom to the sepal. The little shelf of the stigma has a sticky under surface, but you can hardly see this without a microscope. Now you have all the parts and you can see easily how the seed is formed.

The sepal has all those gay paths to lead down to the little lake of honey at its base. The large ant, or one of its friends, journeys down a path, hitting the shelf of the stigma as he passes. As he gets low on the sepal, he rubs against the stamen that is attached to it and receives a shower of light-colored pollen on his head.

When he goes into the next Iris, his dust-covered head strikes the little shelf again and this time its sticky surface catches hold of some of the pollen and uses it to make seed. As the insect goes downward he gets a new coating of dust and carries it to another blossom. You can see that a small bug could pass in and satisfy his hunger without ever touching the stigma. That is why the Iris stores so much nectar — that she can feed many guests, hoping

that one will be large enough to be of service. Do you think the Iris can make seed if the insects do not help her?

Notice the stamens. See how the anthers open at each side to discharge the pollen. You can easily open one yourself. If you take a blossom to pieces carefully, you will see that the stigmas rise from the seed vessel below. Then cut this case open and see the three cells extending its whole length. See how the seeds are arranged in two columns in each cell. Notice how many corners the seed-case has, and which is its widest part. How does it send its seeds out when it is time to scatter them?

Look at the bud of the Iris. You see, if the calyx has become petal-like, the plant has provided another protection. See the inner lining of this leaf-like covering. Is it not like the finest white oiled silk? Do you think any moisture can get into the flower through this wrap? After the blossom leaves this protecting fold, does it live long? Does the Iris close up at night and in bad weather as the Buttercup and Poppy do? Which lasts the longer when

you pick them? Has this anything to do with their sleeping habit?

Have you noticed how the leaves are folded over each other and over the stem? Because of this habit, botanists say they are "equitant leaves," which means "leaves riding astraddle." You can find words that you know from the same root as "equitant." The leaves, where they are folded, have the same lining the flower protectors have. Why do they stand so straight and sword-like, instead of turning on their sides to get as much sunshine as possible? Do you think the cows like to eat them? Have you noticed that the veins in the Iris leaf all run along the length of the leaf, instead of to a large central vein, as do those of the Mustard or Hollyhock? What other plants do you know that have this parallel veining?

When you have been gathering Iris, have you sometimes tugged very hard at a leaf or flower stem and still could not get it up? If you had pulled half so hard at a Poppy, the whole plant would have been uprooted. Dig down and examine this root. See also what makes the

stem so strong. Does the Iris increase by its roots as well as by seeds? By the way, if you plant Iris seeds, will you have blossoms the first year?

The Iris was so named by the ancients because it is beautifully colored like the iris or rainbow. It has always been a favorite flower. It is the national flower of France, where they call it "Fleur de lis." Artists have always delighted to reproduce it in painting or architectural designs. You, yourself, have drawn modifications of it in your school drawing books, and if you look on the covers of the books in the library you will find designs made from its blossom, leaf, or seed-case. It grows native in many countries, and here in California we have three species.

How many of you children know the *Fritillaria* or Checkered Lily? It is sometimes called the Mission Bells and again the Rice Root. It is bell-shaped, with the calyx and **FRITILLARIA.** corolla the same dark color and about the same shape. By looking closely at it, you see that three of the divisions are attached



FRITILLARIA.

to the stem farther out than the others, and you will know that these are the calyx.

The roots of the *Fritillaria*, as one of the common names indicates, are worth looking at. See if you can learn how old a bulb is before it sends up a flower stalk. Notice the difference in the leaves. Does the bulb that sends out the broad shiny leaf early in the spring produce flowers that same year? Compare the veins in the *Fritillaria*'s leaf with those in the leaf of the Iris. These two flowers are distantly related.

There is an old legend that tells why the *Fritillaria* is dark-colored and has such great drops of honey in its cup. It is said that before Christ was crucified the *Fritillaria* was pure white with blossoms held up to the sky. While Jesus was hanging on the cross, all the flowers hung their heads and wept, all but the proud *Fritillaria*, which stood calmly erect. When the Saviour died, a darkness passed over the earth. Then the *Fritillaria* suddenly became sorry for her pride. She hung down her bells, put on garments of mourning, and shed tears of sorrow. She has not ceased grieving yet, for

you can see for yourself the down-turned bells, the sombre gowns, and the ever-present tears.

The *Fritillaria* is a member of the Lily family and you know many of her sisters, as the wild Hyacinth, the Tiger Lily, the Dog-tooth Violet, the wild Onion, and the Soap root. You will find their habits of seed-making easy to observe. Most of them have their three sepals tinted like their three petals, as in the *Fritillaria*, but some, as the Mariposa Lily and the Wake Robin, have the calyx and corolla distinctly different.

In noticing beautiful calyxes, you must look at an old-time favorite, the Columbine. I am sure you all admire it, for I have never met a person who did not feel delighted **COLUMBINE.** at finding its haunts. With us at the sea level it seems to prefer the shade of the lower brush, but up in the Sierra it masses itself in such crowds in the sunshine that it tinges the hillside red.

Take one blossom to examine. You see five petal-like parts hanging downward in the young flower and spreading outward as it matures. These are the sepals. Knowing this, you can

easily guess that the five gold-tipped cornucopias that point upward are the petals. Note that the golden band at the top is varnished both inside and out, while the remainder of the



COLUMBINE.

blossom is unpolished. Would it not be a stupid bird or bee that would not be guided straight to the honey glands? That there is a good supply of honey you can see at a glance, for in the mature blossom the bottom of the cornucopia

is a heavy brown color from the liquid sweets inside.

Knowing that the humming bird admires red flowers, you can see that it will probably thrust its long bill down the tubes and enjoy the nectar at the bottom. While it is doing so, its head will rub against the anthers or stigmas and carry away or leave pollen, as the case may be.

Does the bee get honey from the Columbine? Could not tiny insects crawl into the tube and satisfy their appetites without ever disturbing the stamens or pistils? You see the Columbine has no closed door to keep out unwelcome visitors. She simply waves a great number of stamens and several pistils and trusts that some of them will be able to make seed. Have you not sometimes found Columbines whose lower tubes were punctured with tiny holes? You see that there are robbers in the plant and animal worlds as well as in the human.

Notice the numerous stamens the Columbine has. From the tiniest bud you can see them plainly grouped around the five pistils. Look at them in the bud and then in the full-bloomed

flower. How does the size of the anthers differ? From this observation, do you think all the anthers are ripe at once? Do you think the Columbine can make her own seed if outside help fails? Perhaps you can find out, if you watch the anthers well. In an older blossom you can see the five distinct pistils. As each seed-case matures, watch and see how it opens to let the seeds escape.

There is one thing you must observe well about the Columbine, and that is how she takes care of the stamens and pistils. You see that she is more careless than the other flowers we have studied. Even in the smallest buds, the sepals are a little apart and let in the heat and cold, the rain and wind to the precious seed-making parts. This is one thing that shows us that the Columbine does not belong to a high family. Just as your civilized mamma takes better care of you than the savage mother in Africa takes of her children, so the more highly developed families of plants are more careful of the stamens and pistils than the lower tribes are. They do not raise so many stamens and pistils,



LARKSPUR.

but they turn their attention to making the few they have do perfect work. However, if the Columbine is a sort of savage, unlearned in the best ways of making seeds, she is extremely lovely to look upon; and, as a rule, we human beings care more for the beauty of flowers than for their careful habits.

A near relative of the Columbine is the more fantastic shaped larkspur. You see it, too, has dipped its calyx in gorgeous dyes. Now which

LARKSPUR. is the calyx and which the corolla?

If you think a moment, you will remember that the calyx is the "cup" or outside covering part of the flower. Examine a bud and a blossom and you see that the five velvety parts are the outside gown or calyx. The upper sepal, you notice, has run back into a spur.

Now look for the petals. With a pen or pencil separate the little hood that covers the stamens and pistils. See, it falls back into two petals. Just behind this hood is an upright part that is very stiff when you touch it. Run the pencil point in the center, and it divides into

two parts, each of which extends back into the spurred sepal and at its lower end forms an inner tube. It is in these two tube ends that the honey is stored, and the sepal is only an outside covering to protect them. Another thing is to be noticed about these two petals. They are a slightly different color from the rest of the floral envelope, a little lighter. Thus, they serve as a guide post to the honey they have secreted.

Did you ever touch a tougher, more unbending petal than these two back ones of the Larkspur? With their thickness and the sepal coat so wrinkly and leathery, do you think insects can bite through to steal the nectar? Have you ever found holes in the Larkspur tube? The two hood-like petals protect the stamens and pistils pretty well. You see that they have woolly tops that will cast aside the moisture.

To understand how the Larkspur makes her seed, you must observe flowers in different stages. You will see that the anthers ripen at different times. Notice just where the mature ones stand and how they face. When you have

learned their position, compare an old blossom with a young one, and see what is the position of the stigmas in each.

Then you can watch a bee at work and learn how the pollen is carried about. Do you think weak, thieving little insects can get into the honey tube, past the stiff petals?

When a flower exerts itself to tint its usually green parts a brilliant hue, it is sure to turn out a very beautiful product, one that we admire as much as the birds and insects do. Probably the blossom's helpers care only for the color, while we delight in the form as well. If you notice you probably will find that each flower that wears a bright-colored calyx and corolla at the same time has also developed into a graceful shape. I am not sure of this point, but let us observe together and perhaps in a few years we will be able to state as a fact that a beautifully colored calyx is found only in a beautifully formed blossom.



DUTCHMAN'S PIPE.

CHAPTER III.

SOME PLANTS WITHOUT COROLLAS.

Now that you have seen that the calyx is sometimes as gay as a corolla, you will not be surprised to learn that on some plants it does the work of both and no corolla at all is worn.

How many of you have rejoiced in the early springtime at finding a Dutchman's Pipe? It twines its slender stems over shrubs and hangs **DUTCHMAN'S PIPE.** out its odd, browny blossoms before its leaves appear. Because the flowers are the same color as the dry vine, they are not easy to see; but once you discover them, you will laugh at their funny shape. They look like the pipes you have seen Dutchmen smoking in old pictures. The buds look like funny little ducks, especially if you put them on the surface of water.

This plant has taken so much care to make this peculiar calyx that it has had no energy left

to spend on the rest of the flower. It has no corolla, and you will see that it has no stalks for its six anthers, but has joined them on to the style of the pistil.

Do you suppose insects are attracted to the flower? Does it provide any honey? Does it prefer to make its own seed? See if you find any bugs or bees around it. The common blue-black butterfly is often found near the vine, but perhaps it only comes there to lay its eggs. Its caterpillar is very fond of the pod the vine ripens, and so it places its eggs near it. If you watch, you can tell if the butterfly visits the flower and helps it.

The leaves of the Dutchman's Pipe are large and heart-shaped; and if you feel them, you find them covered with a soft fur. Why? The vine makes a graceful drape over the shrubbery and protects delicate plants below from too much sunshine. Some sisters of this plant are cultivated as shady vines for porches and arbors.

A sister of the Dutchman's Pipe that grows native with us is the Wild Ginger. You will



WILD GINGER.

find it near shady streams. It is low and creeping, with pretty kidney-shaped leaves which give out a fragrance if you crush them. The flower, you see, has no corolla, only a greenish purple calyx which divides into three tail-tipped sepals. In the bud these tails are folded in; but when the blossom opens, they pop far out and give the flower somewhat the appearance of a spider. You can examine the twelve stamens yourself and see if they all are equally long. Notice how they turn. Do you find any bugs around the blossom, or do you think the Wild Ginger makes her seed alone? Notice how large the seed is and see how the plant casts it out to make its own way in the world. Notice, too, how the roots come up over the ground and see what is at the tip of each.

Those of you who have been to the coast will remember the Sand Verbena, sometimes with yellow blossom, sometimes with rose-color, but **SAND VERBENA.** always with a fresh fragrance. Its attractive dress is just its calyx, and this is so pretty that the plant does

not bother to put on a corolla. With such a pretty gown and such an amount of honey, do you think the Sand Verbena will be lonesome for guests? Which ones have you seen visiting her?



SAND VERBENA.

You will notice that the leaves of both Verbenas are not shaped alike, but you will find the leaves and stems of each plant so gummy that the sand around clings to them wherever they touch it. You can see that the little plant,

living where the fierce sea winds tear over the beach so many days a year, would be uprooted and blown to destruction if it had no way of anchoring itself. That is why it grows low and glues the sand to it. Why does it have such thick leaves and stems? Have you examined the root? You might find a new delicacy for a dolls' party there, for it is said that the Indians used to relish the root of the yellow Sand Verbena.

While the Verbena holds itself down from the cruel blast, it takes advantage of that enemy's power to distribute its seeds. You will find the seed-cases winged, ready to sail off on any passing breeze. See if you can find a baby plant far off from any of its relatives.

Another plant that has a pretty blossom without having a corolla is one that you all know, the California Laurel. Perhaps you call it the "Bay Tree" or **CALIFORNIA LAUREL**. "Spice Tree" or "Mountain Laurel," but I am sure you have all seen it. Watch the buds and see how the blossoms are protected before they come out to the sunshine.

When the flowers appear you will find that there are no petals, only the six yellowy cream sepals which shine like tiny stars among the dark green leaves. You will see that the



CALIFORNIA LAUREL.

stamens are fastened to the tube of the calyx. Notice the three inner ones. See how each has on either side of its base an orange-colored gland. What do you suppose this is for? Do you think the Laurel is expecting visit-

ors? Have you seen any accepting her hospitality?

The fruit is roundish and as it grows old is brownish purple, something like a ripe olive. In November and December the fruit falls, and the new blossoms appear shortly after. Indeed, the Laurel has a great desire to produce fruit, for even in summer you can often find some waxy blossoming clusters on the large trees. The seeds start in to grow soon after they reach the ground. Dig up a young tree, say one five inches tall, and see if the fruit is not still attached to the plant.

The new leaves of the Laurel are continually appearing. Sometimes they begin unfolding in winter, and as the branch lengthens out new little red-tipped leaves follow its progress. They vary in fading, too. Sometimes they droop and die in the second year, and sometimes they cling on until the sixth. Now they will turn a beautiful gold and fall in their own graceful slenderness, and again they will curl up in a brown mood of dryness.

From the leaves a valuable medicinal oil is

obtained, and they are also used to impart a delicious flavor to soups and stews. The wood is one of the most beautiful we have for interior finish and cabinet-making. But you and I here are most interested in the Laurel's beauty as a living creature, and I assure you it is a tree that is worth while transplanting to our gardens and making a friend of.

Do you know the wild buckwheat family? It too has no corolla, but it gets along well with its six parted calyx and its plentiful store of **BUCKWHEAT.** honey. It is so generous because it really must have help from the insects. At first it cuddles its three stigmas down in the center of the flower and holds the nine anthers up high and straight. Then, when all the pollen is discharged, it raises the stigmas up erect where they can be hit by the passing bee. Notice its dry stem and hardy leaves and reason why it bears them so.

You will find many another flower that has a calyx and no corolla if you look among the weeds of your neighborhood. The Dock, the Smartweed, the Pigweed, the Wild Rhubarb,



BUCKWHEAT.

the Tumbleweed, and the Four-o'clock are among the number. Learn how many of them have bright-colored calyxes and how many offer honey. See if they produce a great quantity of pollen and notice whether their anthers and stigmas are ready to make seed at the same time. In fact, you will find that they have as many interesting habits as some of the flowers that attract more attention by their beautiful extra gowns.

CHAPTER IV.

SOME PLANTS WITH UNITED COROLLAS.

Most of the flowers you have studied thus far have had the petals distinct from each other. As you look among your plant friends you see that all do not form their blossoms so, but that some unite the divisions of the corolla into one piece.

There is the Manzanita, with its white and pale pink flowerets looking like little waxen lamp chimneys. They are so full of honey that **MANZANITA.** even we dull mortals can smell their fragrance at a distance; and the bee, with his more acute sense of smell, comes from miles away to sip their sweets. Have you examined the stamens of the Manzanita? You see the anthers are made like little pepper boxes, and when the bee strikes the stamen the pollen is sprinkled over him.

The berries of this plant have given it both its botanical and its common name. It is called

Arctostaphylos, or "bears' grapes," because old Bruin is so fond of the fruit, and the Spanish Californians named it "manzanita" because the berry looks like a "little apple."



MANZANITA.

(Photo by W. S. Jepson.)

The Indians used to eat the fruit raw or make it into a meal, as they did the Buttercup. Some housekeepers make a jelly and also a vinegar and a brandy from the berries, and from the leaves they brew a tea that remedies many

bowel troubles. The druggists, too, use the leaves to make a cure for catarrh of the throat or stomach.

Have you noticed how the Manzanita twists round its leaves so that their edges face the sky instead of lying flat as in most plants? There is a very good reason for this. The sun shining on the leaves helps the plant make its food, but at the same time it draws out moisture. The Manzanita wishes to store up all its moisture for the dry summer season, so it not only thickens its leaves but turns them so that the midday sun will not strike them. The morning and afternoon sunshine will reach them and give enough warmth to keep up the food supply. Not all Manzanitas twist their leaves so, but one of the most common does.

Look at the bark of the Manzanita. Is it as thick as that of an oak tree of the same size? If you have watched the Manzanita casting off its old coat, you will understand why its outer garment is thinner than the oak's. At what season does the Manzanita throw off her bark? Does it all come off at once? While it is

peeling, are the more tender inner parts of the branches exposed to the air, as they would be if you cut off a piece of the bark?

The Manzanita belongs to a particularly beautiful family, the Heaths. Some of its members are the Huckleberry, the Azalea, the Salal, the Wintergreen, and that handsome tree, the Madroño. I think you will agree with me

that this tallest daughter is beautiful **MADROÑO.** enough to shed glory on any family. Its sprays of white bells are something like the Manzanita chimneys, only rounder. You will see that the top of the corolla has five teeth, and that the calyx is in five parts. See how the corolla incloses both the stamens and pistil, and see if you think the blossom fertilizes itself or attracts insects to its aid. What makes you think so?

In the late Fall you can find the winter buds that are shielding the new leaves and flower sprays. If you watch, you will be well repaid by catching an early glimpse of the baby leaves which come out in the springtime, pale pink or a tender green. Notice how, as they grow



MADROÑO.

sturdy, the upper surface is glossy and dark green, while beneath they are nearly white. They seem to have a delight in color, for in their second summer, before they are cast from the tree, they bedeck themselves in brilliant scarlet or orange, as if to make an exit in a glorious sunset.

When you are examining the bright scarlet fruit, you will find it divided into five cells, just as you found the flower in the spring having five parts. Why do you think the surface of the berry is so rough? Do you like the taste of it? When I was a child, I used to think it was a mixture of honey and cayenne pepper.

As you admire the ruddy fruit, you will see how well the name *Madroño* fits it. "*Madroño*" is the Spanish for strawberry. Be careful that you do not pronounce it "*madrona*," as some Americans do, for that has an altogether different meaning. Every California child should learn to pronounce correctly the Spanish names that linger in our State, for they are part of our history. Are you not glad that so musical a name is attached to this handsome

tree? I think we can safely state that the Madroño is the most beautiful North American evergreen that has perfect flowers. Its tall straight trunk, its rich-toned bark, its lustrous dark leaves, its bell-like waxen blossoms, and its ruddy berries make it a joy from the beginning of the year to its close.

Another plant that bears a united corolla is the Snowberry. You probably know it best by its fruit. It grows so many places in the State

that you all must have seen it.
SNOWBERRY. If you hold the white berry too closely in your fingers, the outer skin breaks and the inner softness oozes out. Inside this you find two little nuts. Perhaps you think these are the seeds. Open one. You see the Snowberry is as careful of her seed as the peach or plum tree.

In the springtime examine the little pinkish bells that make such careful seed-cases. The calyx, you find, has five teeth. Does it fall off when the seed is formed? The corolla sometimes has four lobes and sometimes five. Open one with a pin. Why do you suppose it is so



SNOWBERRY.

hairy within? Notice to what the stamens are joined, and look at the pistil. Do you think the flower gets the insects to help her?

The Snowberry is a member of the Honeysuckle family. Some of her sisters, as the Honeysuckle, climb over other plants, while others, as the Elder, reach up alone to the sky. Some have their leaves folded around the stems, while others have theirs spread out and cut into parts. They all have an attractive fruit, whether it be gleaming white, glowing red, or polished black.

Do you all know the monkey flower or *Mimulus*? *Mimulus* is Greek for "ape," so that the botanical title agrees with our common name, although it sounds a trifle more musical. Do you think the blossom looks enough like a monkey to deserve this name?

There are ten different species of *Mimulus* in our State, all herbs but one. This one shrub you have all seen, for it is common in every **MIMULUS.** locality, and it exhibits some blossoms during each month of the year. In different parts of the State, it varies the color of

these blossoms from red to pale yellow, but the gown most frequently worn is a bright salmon. The shrub grows sometimes quite tall; and, when covered with bloom in spring and summer it makes an ornamental garden plant that Europeans are glad to cultivate. Its leaves are so sticky that they have earned the plant its second botanical name, *Glutinosus*, which you can easily guess means "glue-y."

Notice the flowers. You see that the *Mimulus* does not crowd them together on the top of the stem. Has she need to, with such large, showy blossoms and blooming as she does at all seasons? Look at one flower. You find the green calyx bell with five points, showing that there are five sepals united into this form. From the center of this bell grows out the funnel-shaped corolla. You see that it has five lobes, each of which represents a separate petal. These lobes are so arranged that two together stand up, and three unite into a lower platform. Botanists call these two divisions "lips," and the whole family to which the *Mimulus* belongs,



YELLOW SNAPDRAGON.

a very numerous one indeed, is said to be bilabiate or two-lipped.

When you glance into the blossom of the *Mimulus* you see at once the two white shiny divisions of the stigma spreading outward. Touch them with your finger and see how quickly they fold together. When they are closed you see below the four stamens. Then at once you think you know how the *Mimulus* accomplishes her seed-making. The insect alights on the three-lobed platform, and he finds two ridges leading from it down the throat of the corolla to the honey glands. As he starts down one, he hits the large lobes of the stigma and they take off what pollen he has brought. As they close immediately, he passes down to his meal and jostles the stamens as he goes. Then the anthers open and pour their dust on him, to have it carried to another *Mimulus*.

This sounds very reasonable, but you may be mistaken. You cannot judge one flower by what you have observed in others—not wholly. You would better watch the *Mimulus* and see what does help it. If a small bug visits her, he

can easily slip in and out without ever moving the stamens or stigma. Could a bee force itself down the long narrow tube, or unroll its tongue far enough to reach the dishes of nectar? Watch the humming bird. It is one of the greatest helpers of flowers. Its long tongue could touch the bottom of the tube; but the humming bird is not supposed to care much for yellow flowers. It would gladly help the *Mimulus* when she wears a red gown. Does it visit her when she dons yellow? If you observe this well, you may be of assistance to science.

Another common *Mimulus* is the yellow one which grows in marshy spots, and which holds its lips so close together that it is often called "Snapdragon." Its yellow is **SNAPDRAGON.** dotted with reddish brown, and it has a fence of fine hairs to keep the small insects from getting into its throat. Its leaves, you will notice, are quite different from those of the sticky *Mimulus*, and its stalk has an individual way of sending out new roots.

The larger family of which the *Mimulus* is a

member is the *Scrophulariaceæ* so named because it was supposed to be useful in curing scrofula, and to this family belong a number of our prettiest wild flowers. The Indian Paint Brush,



SNAPDRAGON.

the Indian Warrior, the Owl's Clover, the Pentstemon, the gay Collinsia, the useful Bee Plant, and the delicate Speedwell are known to most of you. You see they are all quite different in appearance from the *Mimulus* and from

each other; but if you examine a blossom of each kind you will find that, however fantastic the corolla seems, it is really two-lipped. They have different arrangements of their stamens



INDIAN PAINT BRUSH (SCROPHULARIACEÆ).

and pistils; but their seed-case has always two cells.

Their seed-cases help to distinguish them from another two-lipped family, the Mint, which



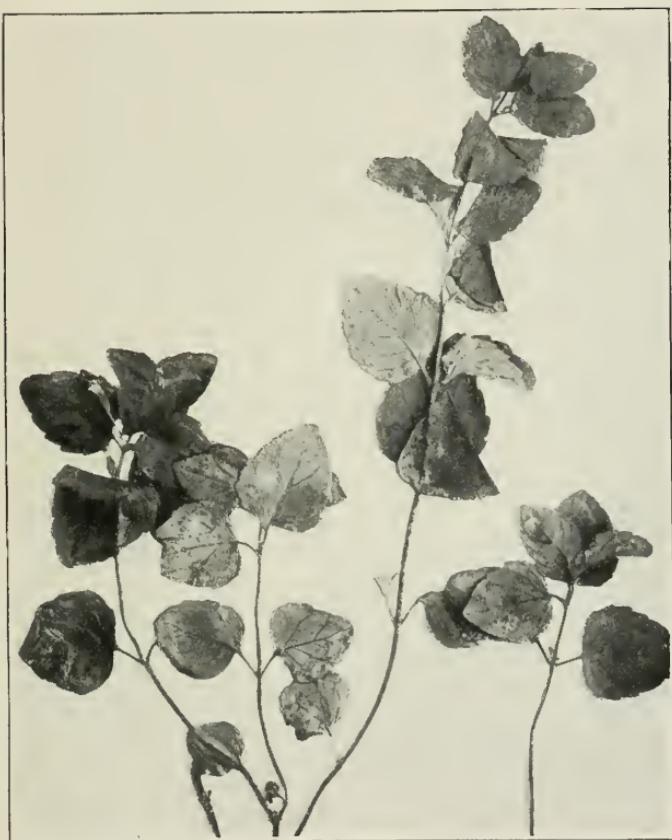
MINT FAMILY.

has its seed-case separated into four nutlets.

MINTS. The Mint family has another striking difference. Rub your fingers along its stem. You both feel and see that it is four-cornered, instead of being smoothed down like those of most plants. You know that the common Mint is fragrant. So are most of its sisters, and the majority of them are useful to man.

The creeping little Yerba Buena, besides being a good medicine, has been connected with the history of our State. Because of its

YERBA BUENA. presence on the hills near the Bay of San Francisco, the city of San Francisco was first named Yerba Buena. It remained so until January, 1847, when the name was changed by order of the *Alcalde*. Much as we love the tiny vine, San Francisco seems a fitter name for our metropolis, and it seems odd to read the newspaper of that day and see that it grumbled at the change. The island in the Bay that is sometimes called Goat Island is also named Yerba Buena. Have you noticed how the Yerba Buena manages to cover



YERBA BUENA.

so much ground? See how it sends down fresh rootlets from the stem and gets new strength from Mother Earth every few inches.

You have all heard of the market value of "white sage honey," and many of you have



WHITE SAGE.

tasted its quality; but have you thought of the flower that makes it possible for **WHITE SAGE** to us to enjoy such a luxury? The Sages are prominent members of the Mint family. Throughout the State the smaller

herbs grow, but the shrubs that reward the bees most generously flourish best on the hillsides of Southern California.

The White Sage seems to wait just for the bees. It sends its two stamens and the top of its pistil far out beyond its corolla, so that no small insect, if he came to visit the blossom, would touch them. Then, to be sure that no tiny creatures will get in and feast without an exchange of benefits, it folds up its lower lip as a door and places a regiment of hairy guards in its tube. When the bee comes, he opens the folded lip; and, so as to get a sure footing while he reaches his tongue into the dish, he throws his two legs over the two stamens. This action draws the stamens near his body and the anthers throw their pollen on his sides. Then, when he goes to an older blossom, where the stigma is ready to make seed, it catches hold of some of this dust. The bee gets abundant payment for his service, and we profit by his labor.

A smaller Sage which grows throughout the State, and which has crowded rings of blue



CHIA.
Showing Leaves.

flowers around its stem, has a seed that is very nourishing. The Indians called it "Chia,"

CHIA. and used to eat it dry, or make it into a gruel, or add it to water for a refreshing drink. They said that one tablespoonful of these seeds was sufficient food for an Indian for a day when on a forced march when he could not carry heavy foods. This is a good thing for us to know. Sometimes when we get hungry away from home, we can help ourselves from the little gray tables the Chia sets beside the roadway.

Among our wild flowers you will find many other species that unite their petals into a solid corolla.



CHIA.

Showing Flower Heads

Botanists think that this shows a higher plant family. Do you think a corolla of one piece can be seen by the insects at a greater distance than one made of separate petals? Which kind of blossom do you find holds the most honey? Which has the greater number of stamens and pistils? Which ripens the most seeds? Which has the best means of getting its seeds scattered over the earth? After all, the plant that knows how to make the best seed and how to get this seed well started in a new life is the most successful plant in its own work, whether its corolla be in one piece or in many petals.

CHAPTER V.

SOME PLANTS WITH MECHANICAL POWERS.

What child in California does not know the Lupine, with its bright plumes waving from the sea sands to the Sierra'n rocks? There is not a month in the year when you cannot **LUPINE.** find a few of its blossoms, whether they be blue, purple, yellow, or white, or whether they cuddle close to the Earth's bosom or stand up boldly to grace the landscape. Some invite visitors from afar by messages of their strong fragrance; others wait quietly in their pretty dresses, hoping their color will please the passer-by.

Notice that the Lupine masses a great number of her flowers around the top of the stalk, and together they make a dash of color that attracts not only our eyes but the eyes of insects. If the Lupine had as few blossoms on a stalk as Baby-blue-eyes has, she would be lonesome quite often. Then, too, the stalk of



LUPINE.

many flowers, each ripening a little later than the others, lasts many more days than one blossom would, and so has a double chance of receiving callers. You might observe that the different Lupines arrange their flowers around the stalk in different ways, and see which way you think makes the prettiest effect.

Take one little blossom off the stem. You see that it is like the pea flower. The Lupines are members of the Pea family, which is one of the most interesting in the world. It is called the *Papilionaceæ*, or butterfly family, because of the shape of its flowers. Let us look at a flower together. The hairy calyx does not vary much from others you have examined. The corolla, however, is different. Each part has its own name, and this is true of the whole Pea family. The larger petal that folds over the others in the bud and then throws its edges backward as the flower opens is called the banner. You see it is the prominent part. The two side petals are called wings. When you open the wings, you find inside a curved petal part that will remind you of the keel of an old-

fashioned boat. Because of this likeness, this part is called the keel. If you look at the lower part of the keel, you will find that it is made of two petals that have joined their top edges to better protect the pistil and stamens. You can easily take the two apart, and when you do, you will find up in the tip of the keel a goodly store of rich orange pollen.

We must study the ten stamens to see how it got there. You see that they are united at their lower part around the lower part of the pistil, and that some are taller than others. Now look at the anthers of the taller ones. See that they are roundish knobs, while the anthers of the short stamens are long and narrow. If you open a bud you will find the stamens in it about the same height, but the anthers will still be different. As the blossom grows, the stamens with the ball-like anthers rise up tall and pack the orange dust in the top of the keel. If you wish to see why they put it there, just move the lower part of the wings with your finger or a pin. See how a little lump of pollen spurts out. That is what happens when Mr. Bee alights on

the wings and fumbles around. The bee is very fond of the pollen of the Lupine and packs what he can in his little baskets, but some of it always catches on his head and back.

If you have noticed the pistil, you have seen that it grows out of the keel when the flower ripens. As soon as the banner stands erect, the pollen is ready to be discharged, but the stigma of the pistil is not ready to receive pollen for some time. If you work the keel, you will see that when the bee is trying to get the pollen, the pistil must hit him first. If it is ready to make seed, it will take the dust on his head that he has brought from another flower. The Lupine secures most of her seed in this ingenious fashion. Is she not a skilful engineer? If a bee does not happen along when the stigma is ready for seed-making, she can use the pollen of her own blossom.

The seed-case of the Lupine, you know, is like a pea pod, or legume. Indeed, the larger family to which the butterfly family belongs is called *Leguminosæ*, because of its seed-cases. The Lupine has a mechanical plan for scattering

its seeds, just as it has for dropping its pollen. Watch a dry pod and see how it works.

The leaves of the Lupine are carved into a number of leaflets. This gives less surface than if they were all solid leaf. The Lupine does not want too much leaf surface, because she does not wish the leaves to send out her moisture under the sun's strong rays. That is why the leaves are generally so well coated with silvery hairs. These hairs reflect the light and do not let so much get to the leaf. Then, too, the leaflets fold together at noonday so as to get less light. Watch them.

Because the Lupine is so fond of moisture, she sends her roots down sometimes twenty feet to seek a damp layer of soil. This habit has made it possible for us to have our beautiful Golden Gate Park. All that part of the San Francisco peninsula used to be sandhills, and the sand shifted so with every wind that no trees would grow. Some one discovered the Lupine's manner of rooting and the sandhills were covered with little Lupine plants, with barley seed scattered in between them. The

barley grew rapidly and held the surface sand from blowing away. By the time the barley died, the Lupines had sent their roots deep and could brace themselves against the wind and could hold the sand with them. Then trees were planted, and in a few years the bare sand-hills were transformed into the place of beauty we are so proud of. The name "Lupine" comes from the Latin word that means "wolf," and it was so called by the ancient botanists because of its root, which, they said, "devours the soil." Do you think it does?

The Lupine has many sisters roaming over the State. They all have some mechanical device for making insects carry their pollen or for scattering their seeds. One that lives well

ALFALFA. in the dry season because of its deep roots is the Alfalfa. The tiny blossom, you see, is butterfly-shaped. Being so small, it does not trust to its appearance to attract insects, but sets out some honey. This can only be reached through two little doors on the upper side of the wings. When the insect reaches in his tongue for the honey, it separates



ALFALFA.

parts of the wings, and these cause the pistil and stamens to jump up like a *Jack-in-the-box* and hit the tongue. The bees and the butterflies do not like this rude treatment, and they have learned a way of putting in their tongues from the lower side of the flower and securing the sweets without receiving the blow.

So Miss Alfalfa, be-

cause she is impolite, does not get the aid she desires. Take a pin and imitate the bee's tongue and see what happens to the wings and keel after the stamens and pistil deliver the stroke.

Notice how the Alfalfa legume is coiled. How do you think it travels and how does it discharge its seeds?

The Alfalfa is not a native of California. It was born in Media, in Southwestern Asia, and from its birthplace received its botanical name of *Medicago*. It was cultivated in Greece several centuries before Christ was born. Think how long ago that is! It traveled to Spain and then through Mexico to our State. You know what a good forage plant it is, and in South America it is found useful in another way. Sprays of it are hung in the houses to banish the fleas.

Another interesting plant that came with the Spaniards is the Bur Clover. It, too, was born in Asia and crossed over to Spain with the Moors. From thence it traveled through Mexico

BUR CLOVER. to us. Its tiny yellow flowers store a great deal of honey; but the insect to get it stands outside and thrusts in his tongue. Then the pistil and stamen act as rudely as do those of the Alfalfa, and the force of the blow changes this flower's shape also. The wise insects treat it as they do the Alfalfa by stealing its honey from its base and not approaching its mouth.



BUR CLOVER.

The seed-case of the Bur Clover is interesting. You will find it first a little pod like that of a pea, but with two rows of teeth on one edge. Then the pod takes one little twist and then another and another, until finally it is the little prickly coil that catches in our clothes and that can be unwound into a corkscrew shape. By clinging to a passing body the bur is carried away from the mother plant.

When the bur is dropped in the dust, it behaves differently from most seed-cases. As it dries, it holds close around the seeds and does not let them out. When the rain falls, the little burs get anchored in the earth, and the seeds start growing inside the bur. They send out roots below and stem and leaves above, while they lie snug in the warm bed. Plant a bur in a box and watch how it grows.

In the Wild Pea you will find the stigma different from those of these other members of its family. You see it is a little hairy bunch, and it brushes out the pollen to the insects.

WILD PEA. Are the stamens arranged as in the Lupine? Notice the leaf. Are the leaflets attached to the stem in the same way as those of either the Alfalfa or the Lupine? Look



WILD PEA.

at the tendrils at the top of the leaves. Do they all twist in the same direction? Has the sun anything to do with the way they turn? Does the Wild Pea grow in shady places where it needs the tendrils to help it up to the sun-

shine, or does it rest on its neighbors because it is too indolent to stand alone?

These are only a few members of the Pea family. The Clovers, the Rattleweed, the Lotus are creeping on the roadside, and some of the most beautiful cultivated flowers belong to this sisterhood. You will find each one different and each one wonderful in its devices to best accomplish its life work.

Another plant that came with the Spaniards from Europe and that has a mechanical working seed-ease is the Filaree. By the way it has climbed from the sea to the mountains, **FILAREE.** you can see that it likes its new home. Its name, Filaree, is the shortened term for the Spanish *Alfilerilla*, which means "a needle." Can you tell why they called it this? The way the little magenta flower makes its seed you can easily study for yourself.

When the petals drop off, the five little pistils start in and grow until they are about two inches long. Perhaps you call them "clocks," and find out "if your mother wants you" from their unwinding. The green pistils form good

dolls' scissors, if you put one bill through the other.

The qualities that make these seeds good playthings for children are what the mother



FILAREE—ALFILERILLA

plant has developed to get them well started in a new life. Some warm day in April or May the dried fruits give themselves a twist and fly off the stems. Some, as they fly, are caught by the wind by the long silky hairs that you see on

the end. Others fall to the ground. Now, if you notice the lower part of the seed-case you will find that it has on the end a little hook and on its sides little bristles that curve upward and outward. You know they often stick in your clothes as you pass and you carry them to new fields, or perhaps a sheep performs the same service.

When the seed-case falls to the ground, if it be warm weather, it curls its parts; when fog or dew falls, it straightens them out; with more sunshine it curls up again. By doing this over and over again, the seeds screw themselves down under the earth and are ready to spring up into new plants as soon as the early rains fall. You can see how the seed-case works if you put one in water and then in the sunshine.

The Filaree is a member of the *Geraniaceæ*, or Geranium, family. *Geranium* comes from the Greek meaning "crane's," and refers to the seed-case, like a crane's bill. The Filaree's own botanical name, *Erodium*, is from the Greek for "heron," and is also called so because its seed-case resembles a heron's bill. If you watch the



JOHNNY-JUMP-UP.

seed-cases of two of the Filaree's sisters, the Crane's Bill and the Oxalis, you will find that they too have mechanical genius.

In noticing seed-cases that have this engineering power, do not forget to watch that of our large yellow violet, the Johnny-jump-up. If

JOHNNY-JUMP-UP. there be one wild flower that is loved by the boys better than another, I am sure it is the Johnny-jump-up. Girls love it, too, but they have other favorites; while every boy I have known, whether his age was seven or seventy, seems to have a tender place in his heart for this sunny-faced beauty. Perhaps it is because they used to play "fights" with the blossoms, by locking two heads and pulling until one or the other was decapitated. Then, too, we used them in the same way to see if our companions "truly loved" us. We named them for two friends and the one who remained victor in the fight was the one whose affection could be depended upon. Probably you children to-day have wiser methods of testing your friendships, and love the Johnny-jump-up simply for its own sake.

You have noticed that the two upper petals are a rich brown on the outer side and pure gold on the inner, with delicate veinings leading down to the flower's center. The three lower petals have dark purple lines, which, you know, are honey paths. If you pull out one of the side petals, you will find that the honey paths are only on one half of it, while on the other half, a little above where it joins the rest of the flower, is a brush of fine yellow hairs. Then, if you look again at a perfect flower, you will see that the two little brushes on the two side petals form an arch over the precious pistil and stamens and keep out any moisture that might tend to harm them. Now look at the lowest petal of all. See how it curves up just in front of the pistil, making a little platform, and then narrows down behind and loops itself around into a little hood. If you pull off this petal, you will find within its hood what the insect is seeking.

Take a complete flower again and notice that the round green top of the pistil is lying close down on the platform of the broad petal. You

see nothing can get to the honey without touching first its sticky surface. In the entire flower you see a spot of red above the green stigma. Look at the blossom you have been picking to pieces and see that this is part of the ring of stamens that encircles the pistil. You can easily divide the ring into five stamens. Notice that the two just above the largest petal have an additional growth that the others lack. Where does it project and what is it for?

The bee gets a good footing on the brushes of the side petals and then unwinds his long tongue and pushes it under the club of the pistil and back into the honey safe. While he is wiping it around, the anthers drop their pollen upon it. Then, when he goes to the next-door *Johnny-jump-up*, his dust-covered tongue touches the stigma and it grasps the pollen it needs for seed-making. In spite of the fact that it has few insect visitors, *Johnny-jump-up* manages to produce a great quantity of seed. By watching the workings of its seed-case, you will learn how a hillside be-

comes covered with the yellow blossoms in a few years.

Even if there was a total loss of seed one year we would still have some Johnny-jump-ups the next, for the plant does not die when blossoms and leaves entirely disappear from the surface of the earth. The rootstock below ground is still strong and is waiting for the early rains before it sends up new leaves. You will find it a tough root, and the stem of the plant, too, has an unexpected strength. If you break the stem, you see an inner column that seems to be separate from the outer covering. Twine this inner part and you see the different fibres that bundle together to make the stem so strong.

The Johnny-jump-up has eight sisters, natives of California. They wear differently colored gowns, blue, purple, yellow, or white, and differ in their leaves and stems or markings, but they all have the same device for seed making and the same way of scattering their seeds. The cultivated violet and the gorgeous pansy, too, as you might guess, are members of Johnny's

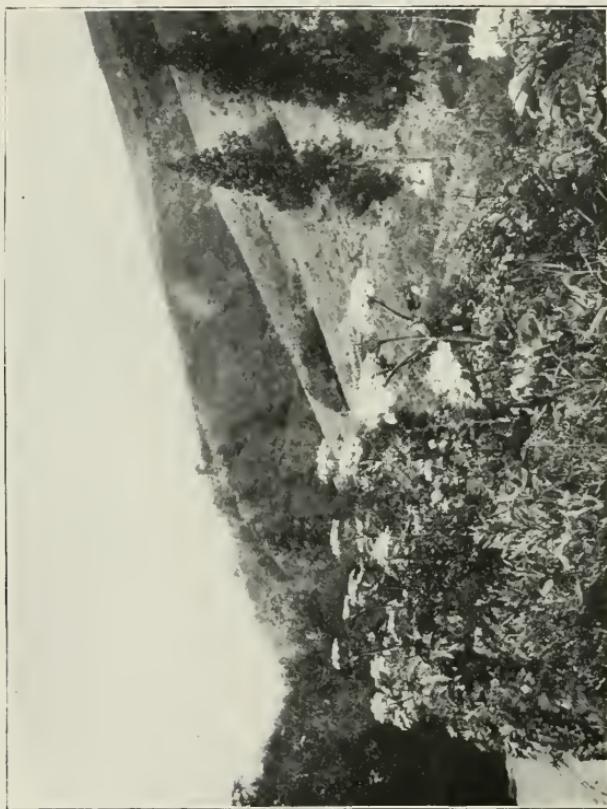
family, the *Violaceæ*, and from watching these domestic relatives you may become familiar with the whole kin.

You will find that most plants that display any engineering ability use it either in getting their pollen exchanged or in distributing their seeds. Watch the seed-cases of all the plants around you and see which exhibit any mechanical power.

CHAPTER VI.

SOME PLANTS WITH NEIGHBORLY BLOSSOMS.

If you recall the plants you have been used to all your lives, you will remember that they have different ways of grouping their flowers. The Trillium has but one blossom on each stem that rises from the rootstock; the Iris has several, although they generally bloom out at different times; the Lupine has a great number arranged around the top of its stalk, with many of them in bloom at once. If you think over the others, the Baby-blue-eyes, the Poppy, the Mallow, the Mint, and so on down the list we have considered, you can place them in one of these three classes. You have learned that plants in general arrange their blossoms so as to get aid in their seed-making and that each family has its own special way of accomplishing this object. To-day we wish to observe some plants that have developed other ways of grouping their flowers.



(Photo by Eisen.)

UMBELLIFERÆ.

Do you know the "Yellow Mats" or "Foot-steps of Spring" that rush out after the earliest rains of the New Year and paint the hillsides **UMBELLIFERÆ.** gold? If you do not have it in your vicinity, you surely have the Wild Carrot or the Celery, the Fennel or the Cow Parsnip. All of these belong to the same family, and any one of them will serve to study the arrangement of the blossoms.

Pick a flower stalk and notice how the tiny florets have stems of different lengths, so that their edges coming together form an umbrella-shaped cluster. This habit gives the family its botanical name, *Umbelliferae*, which you can easily understand. You will find that the large complete umbel is made up of several smaller ones. This mass of bloom, which is generally white or yellow, attracts a great number of insects, both large and small. You will find the honey spread out in the center of the little blossoms so that any visitor can dine. The Umbelliferae are not at all reserved and receive the commonest of beetles and flies and bugs.

Examine well the different florets and see just



UMBELLIFERÆ—COW PARSNIP.

(Photo by W. S. Jepson.)

how many are alike. You will find that the Umbelliferae, unlike the Columbine, have only a few stamens and a two celled pistil. See if the anthers and the stigmas both mature in the same floret. If they do, are they ripe at the same time?

Many of this family look very much alike, and the chief way of distinguishing the species is by their fruit. Take a little seed-case in your hand. Notice how readily it separates into two parts, each containing one seed. Observe the ribs that extend the length of the case. See if in these deep ribs you can find fainter ones. Is there not a sweet fragrance about the seed-case? Cut it across and you will see lines of little dots. These are the oil tubes that you have laid open. Do they run the same way as the ribs or across them; on the ribs or between them? This oil is what makes the seeds aromatic, and from this family we get our fragrant Caraway, Dill, Fennel, Coriander, and Anise seeds. Some of the family are poisonous, so you would better not taste any of the seeds you are not positive are harmless. The seeds of the Wild Carrot

earn the Spanish Californian name for the plant, *Yerba de la Vibora* (viper herb), because they furnish a cure for the bite of the rattlesnake.

When the seeds are ripe, notice the different modes they have of getting carried around the world. The Yellow Mats has little hooks that attach themselves perhaps to your clothes, perhaps to Fido's coat, and insure a journey away from their native heath. See what the Cow Parsnip and the Wild Carrot substitute in place of the hooks.

The Umbelliferae have hollow stems, with little grooves running up and down them. Has the stem any joints in its central column? Did you ever break off a stem? Does it come off a clean even break? Is it easy or hard to break off? Why?

Look at the leaves. They are cut into many divisions. Some of them, as the Parsley, we use on our tables. Notice how the leaf stalk flattens out and clings around the stem. This leaf stalk is what we eat in the cultivated celery. Have you observed the little bundle of leaves around the bottom of each main flower stalk

and the tinier bundle around each branching flower stem? Do either of these bundles of leaves look like those lower down on the plant and do they look like each other?

The roots of the Umbelliferæ you may know better on the table than in the ground. The Carrot and the Parsnip are good examples. How long does it take the plant to raise a parsnip for your dinner? How many can each plant develop?

The Umbelliferæ family is a large one, there being about thirteen hundred members known to man. A great number are edible, others are fragrant, and a few poisonous. So that, while we find interest in the family's intelligent manner of massing its flowers for its own purpose, at the same time we are much indebted to it for its supplies to our needs.

A family that is even more intelligent in making its seeds than the Umbelliferæ is the Compositæ. This is the very largest of flower families in the world. You meet many of its members on any walk you take. The Sunflower, the Aster, the Dandelion, the Thistle, the Gum-

plant, the Goldenrod, the Everlasting, the Tidytips, the Sunshine, the Brassbuttons, and the Cockle bur, as well as many others, are well known to you by sight. Have you ever examined them to become better acquainted?

They all have a multitude of little flowers crowded together so as to form one head, and the commonest have some gay colored rays

encircling the bottom of this head, **TIDYTIPS.** like a collar. Take almost anyone to examine. I am looking at a Tidytips. The rays are large, yellow with white tips, and have three notches in the top edge. If you pull off one of the rays, you will find it a tubular flower, but without any stamens or pistils. Its only work is to be beautiful and to attract insects to the seed-making flowers within.

Now look at the head. You find it composed of perhaps hundreds of little tubular florets, in three distinct stages of development. In the center are the buds that have not yet opened. Then there are several rows where the flower has opened and from its graceful five-pointed tube a dark column is projecting. This is made

of the anthers, which have joined together around the top of the pistil. Then there is the third stage, nearest the rays. Here you find the five-pointed petal tube and the dark anther column, but through the head of the column have branched out two sticky stigmas. You can easily see them extending, one on either side, waiting for the visiting bug to bring pollen from a neighboring head.

You see the outer flowers mature first. When the anthers are ripe, they discharge their pollen inside the column they form. Then the pistil sends up the stigmas; and, as they seek the light, they push before them the pollen until it falls outside and is carried off by some enterprising insect that has been attracted by the bright rays.

When the outer florets have lost their pollen, the insects crawl over them to the next row; and, in doing so, strike the stigmas. This way of ripening the tiny blossoms at different times generally secures cross-fertilization, or the getting of pollen from a different head. However, if outside help fails, the *Compositæ* makes



COMPOSITE—LAYIA.

its seed by itself. The inner anthers cast out their pollen when the outer stigmas are ready to make seed, and some of it must fall upon them.

When you pull out one of the florets, you find that the calyx is not like the calyxes you are used to. Its lower part is grown close and tight to the bottom of the pistil and its upper part is divided into numerous silky bristles, which are called "pappus." You know how they stay on when the corolla fades and how they help the seeds to float away on each passing breeze. They make it hard to keep the Milkweed, the Old Man of Spring, and the Dandelion out of our lawns.

While this pappus calyx is common to the *Compositæ*, all the corollas are not tubular like that of the Tidytips. Some have all the florets shaped like rays; that is, they are flattened tubes with the petal grown large on one side. Look at the Milkweed for this class or at the Dandelion. These all have milky juice and most of them close in the afternoon. Another group, a smaller one, has its corollas two-lipped like the



SUNSHINE.

Mint. However, the majority of our native Compositæ have tubular corollas.

All of them have a great number of little leaflets folded outside the rays or head, as a calyx is usually around a single flower. These form what is called an "involucre." They not only protect the flower head from cold and moisture, but they make a strong wall through which thieving insects cannot cut to get the honey of the corollas.

Among our Californian Compositæ many are useful to man, especially in making medicines. The yellow flowered Grindelia or Resin-weed is the most important. It blooms in **GRINDELIA.** the summer-time, and covers its bud with some milky-looking resin, so that the sun will not burn it up. Long before the whites entered the state, the Indians used to boil the Grindelia and use the tea as a cure for lung troubles and for skin diseases. It was considered especially good for poison oak. To-day we gather the tops of the branches where the gum is kept for the flower buds, and ship tons of them East each year. These are made into



GRINDELIA.

the medicine "Grindelia" and sent back to our drug stores. When you children grow up, one of you boys or girls might start a business right here at home of making medicines from our California plants.



COMPASS FLOWER.

The Compass plant, which looks very much like a sunflower, also gives us valuable medicines. It usually has but one large flower at the top of a stalk, while the **COMPASS PLANT.** true Sunflower has numerous blossoms near the stem's summit. Its leaves



SUNSHINE.

too, are different. From these leaves it gains its name of "Compass plant." The edges of the leaves always point north and south, so if you ever get lost in summertime, just hunt up one of these plants and ask it to direct you home. They are quite plentiful.

A Compositæ that the Spanish Californians liked is the Sunshine. It comes early in the springtime, lying close to the ground and gilding the hillsides. Its center cone is **SUNSHINE.** made up of many little golden blossoms closely packed together and it is surrounded by from ten to fourteen rays of the same shade of gold. The Sunshine is very fragrant and draws many insects. One that comes to it in some localities is a small fly that likes its pollen. This fly does not confine its attentions to the flowers, but annoys the horses and cattle in the vicinity. Some people, disliking the fly, extend their dislike to the flower that gives it food, and call the Sunshine the Fly Flower.

The Spanish Californians used to call the Sunshine *Si me quieres, no me quieres*, which

means in English "Love me, love me not." They named it this because they used to tell their fortunes on its rays, as we do with the Marguerite. In the deck of cards in those early days of California, the Jack of Spades always held a *Si me quieres, no me quieres* blossom in his hand.

As far as seed-making goes, the Compositæ is the highest ranked of the flower families. By the blossoms living close together they are able to co-operate in their efforts and accomplish better results than a blossom living alone would be likely to do. Just as people living in cities do not have to depend upon their own hands for so much of their living as those who reside far away from any town, so the flowers that live in a crowded community do not need to exert themselves so much as if each swung on a stem by itself.

CHAPTER VII.

SOME PLANTS WITH CO-OPERATIVE BLOSSOMS.

All the plants we have considered thus far have had their seed-making parts, their pistils and stamens, in the one blossom. Perhaps you think all flowers do so. Let us see if that be true.

You all know the Chilicothe, or Wild Cucumber, although perhaps you have not paid much attention to its flowers. Look at them now.

CHILICOTHE. You will find two different kinds of blossoms on each plant, and it takes both these kinds working together to make a seed. The white flowers that grow in clusters, and that are probably the only ones you have noticed, have stamens and produce a great amount of pollen; but they have no stigma to put it on. You see that they could not make a seed alone.

If you look farther down on the vine you will find a little flower, all alone, cuddled close to

the stem. You will see below the white petals a little bur, and above, a sticky knob of a stigma waiting to hold fast any pollen the wind may bring it from the clustered blossoms.



CHILICOTHE.

As yet we do not know that insects carry the Chilicothe's pollen, but if only the wind visits it, the Chilicothe is wasting time to don her white dress. See if you can discover any insects helping her.

The Chilicothe has learned that if one flower

attend to one branch of the seed-making and another flower attend to the other branch, she will make better seeds than if one flower does all the work. For this same reason your mother buys the flour to make her bread, instead of raising wheat herself and grinding it up, as our great-great-grandmothers used to do. We people have learned that by dividing up parts of the work, all can have more time to rest and play; and so, too, have many of the plants learned to save labor in their seed-making.

You know what a successful seed-maker the Chilicothe is. You have watched the large prickly seed-case divide and curl back its sections like white waxen lily petals, disclosing a beautiful lace-like box holding the polished seeds. The Spanish Californian children used these hard seeds for marbles, and many girls to-day use them for "jackstones."

You know what a skilful climber the Chilicothe is, but have you noticed how it gets up in the world? The little twisted tendrils are really branches that the vine has made into climbers to help it reach the sun. The tendril, at first,

is straight as it pushes its way up to find something to cling to. When it gets hold of a branch or something similar, it coils for two reasons—to bring the plant nearer the support and to have a stronger hold in case of storm.

Some of you call the Chilicothe "Big Root," or "Man-in-the-ground," because of its immense root. Do you know why the plant stores up so much food underground? Just to be ready for growing when the next season comes. That is why the Chilicothe can send up young plants on time, even if there be no rain to give them a fresh drink. When we see how the vine covers up many unsightly stumps and fence corners and how it drapes itself gracefully over many a thicket, we rejoice that it has such thrifty habits of providing for the future.

While the Chilicothe has developed two kinds of blossoms for the separate parts of the seed-making, she has kept both kinds on the same plant. Some plants divide the work further than that. They have only flowers with stamens on one plant, and those with pistils on another,

just as some mills make only flour while others make only breakfast foods.

Suppose you study the Willow's seed-making as a type of the plant's highest division of labor. In the late fall the trees stand bare of leaves.

WILLOW. After the early rains, brown buds appear, arranged diagonally up and down the stem. These buds swell larger and larger, and some warm day the brown overcoat is slipped off and soft gray pussies come creeping up the branch. Even the botanists call these "catkins," and surely nothing could be more kitten-like than they when they first burst out.

In a few days, on certain trees, bunches of yellow stamens spring out from the midst of the gray fur, and the catkin becomes a yellow tassel, waving with every passing wind. If you examine one of these catkins, you will find that its fur is made of tiny gray scales, overlapping each other as the scales of a fish do. From under the base of each scale grow the stamens, and as they push upward, they fluff up the scale and make its fuzzy top soft looking.

Besides the stamens, there is under every



PUSSY WILLOW.

scale a drop of nectar so delicious that far-off colonies of bees make a rush to revel in it. As they sip the honey and gather the pollen into their baskets, they get their legs and sides "powdered with gold." Now the question for you is, Where are they going to put the pollen to help the Willow make seed? In the catkin you looked at, there were only stamens; no petals, no sepals, and, more important than all, no pistils. If you examine another from the same tree, you will find the same result. Indeed, no catkin on the whole tree will have any part of a flower but the stamens.

If you look around, you will see another Willow whose catkins have turned green instead of yellow. Examine one of them. The gray scales are the same; the honey drop is there, too; but instead of stamens, there are pistils, each with two moist stigmas ready to catch the pollen the bee or the wind brings. Now you see why the Willow produces pollen so lavishly and secretes such sweet honey. She must have the aid of the wind or the insects or she can never make seed. By having a large amount

HABITS OF CALIFORNIA PLANTS

of pollen, the wind can waste some and still get some to the waiting pistils.

When the pistil ripens, it divides in two and the seeds, each with a fluffy attachment, go sailing off in the air. You have seen many of them. Some fall in the creek and the fluff keeps them afloat until they are landed somewhere down stream; or perhaps they are carried out to sea and finally cast up on a new coast.

Notice the Willow's leaves in autumn. You know that they turn yellow and brown and then are scattered over the ground. We usually say "the leaves fall," but that is not true. The tree casts them away. When the leaf is so worn out that it cannot work much longer, the tree absorbs all its good material and gradually closes up the tubes leading to it. As it shuts the last little door, the leaf is cast off from its home and is at the mercy of wind and weather. If you examine the spot on the twig from which the leaf is shed, you will find that there is no opening through which the sap could escape; There would be if the leaf tore itself away from the tree. Notice it for yourself in the fall days,

when the various trees are casting aside their worn-out garments. Notice the difference between a strong leaf and one just ready to be discarded, not only in the leaf texture but in the attachment to the tree. Trees whose leaves are cast off in the autumn are called "deciduous."

A deciduous tree that has habits very similar to those of the Willow is the Poplar or Cottonwood. Indeed, it is the Willow's own sister. Their family name is *Salicaceæ*, which refers to their habit of living "near water." The Willow's botanical title is *Salix*, which, you can guess, means the same as the family name. The Cottonwood's scientific name is *Populus*, and it received this title because the tree was the common one, the tree of the people, in old Rome.

We have two Cottonwoods, the common, or *Populus Fremonti*, which grows in the valleys and in the Coast Range, and the *Populus trichocarpa* of the Sierras. "TRICOTTONWOOD." "trichocarpa" only means "fruit divided into three valves." You can tell yourself what Fremonti indicates.

The *Populus Fremonti* has its leaves broader than long and green alike on both sides, but the *trichocarpa* has leaves that are longer than wide and that are dark green above and silvery or



COTTONWOOD.

rusty beneath. They both have sealy buds, which you can find on the trees in the fall. As they grow larger, break one open and see how the baby leaves are tucked in this cradle.

The Cottonwoods flower as the Willow does,

with staminate catkins on one tree and pistillate ones on another. These tassels come out before the leaves, so you will have a good chance to view them. Most of these trees which need the wind's aid to scatter their pollen hang out their blossoms before the leaves come to be in the way.

On the Cottonwood catkin, you will find many stamens, perhaps sixty or eighty, crowded on the surface of a little disk. As soon as the dark red anthers open, a great cloud of golden pollen is carried off. Some of this will surely reach the pistils waiting on the next tree. When the pollen is all discharged, the staminate catkin falls to the ground. The pistillate ripens its great number of seeds, each with long silvery hairs to help it sail away. You will be interested to see just how the seeds are attached to the catkin.

Up in the Sierras, there is another *Populus, tremuloides*, which is commonly called the shaking aspen. Its roundish leaves tremble in an uncomfortable way even when the air seems still. They have a trembling aspen in Europe



ALDER—BLOSSOMS AND UPPER STEM.

which, they say, was as quiet as other trees until the Saviour was crucified, but since that awful night it has always shaken in horror at the deed. I think we cannot accept this explanation, as trees only care for their own progression; and some of you boys and girls might find a more reasonable explanation for this tree's conduct, if you notice the angle at which the leaf stalk is joined on to the large leaf.

Along the streams we also find the Alder. One of our two species, *Alnus rhombifolia*, blossoms in January, but the commoner, *Alnus rubra*, displays its tassels in March, when its new leaves are venturing forth. **Alnus ALDER.** comes from a Celtic word meaning "near the river." I think you can guess what the two species' names mean. The Alder carries its two kinds of blossoms on the same tree. The staminate's work is soon done and it falls early. The pistillate grows into a fruit that resembles a tiny cone. You can find out how many seeds it contains and how they are built for scattering.

Another deciduous tree that has both kinds

of flowers on the same plant is the Sycamore. We all have been grateful for its shade that makes our creek banks so attractive. **SYCAMORE.** I wonder if some of you have not found its long half-prostrate branches mar-



SYCAMORE.

velous horses that carried you instantly wherever your wish dictated. I used to take journeys all over the world on a Sycamore steed, and they were most satisfactory, for nothing ever happened unless I willed it so.

And from the Sycamore's broad leaves, we used to weave wreaths and sashes and dolls' dresses. .

When these leaves are being cast aside, you can see just where the leaf bud for the next year is hidden. If you think about it, you will see that the tree places its buds where it is easiest to bring them food, either at the end of the twigs or where the leaf stem joins the branchlet. Notice if all the buds come out each year. Have you ever wondered how a tree that your papa has pruned can so quickly send out new growth? Perhaps if you watch the winter buds and then in summer do some clipping for yourself, you may learn its secret.

While, of course, you have noticed that the Sycamore casts away its leaves, have you observed that it also scales off its bark?

The winter buds of the Sycamore are well protected, and when they let the young leaves peep out, you will find that each little leaf has not only its own furry coat but also a brown woolly overcape folded around it. As the leaf grows, the cape does not fall off, but turns green, too, and helps in the work of the tree.



MAPLE.

The grown leaves, you know, are broad, deeply lobed, and with large veins. The broad leaves give the Sycamore one of its botanical names, *platanus*; the other, *racemosa*, comes from the way its flowers and fruits are arranged. The flowers are clustered into balls hanging down at different places on a stem. Each pistil and each stamen is a flower by itself. When the fruit ripens, it forms green balls. These look like beads threaded on the zigzag stem. If you break one open, you will see how the seeds are provided with downy sails.

A deciduous tree that has very noticeable seeds is the Maple. These are not so plentiful with us as in the North and the East, but still they are frequent enough for most of you to have seen their deeply cut leaves and their large winged seeds. Fortunate are you children who live where the leaves turn red and gold instead of crumbly brown as they do in the **MAPLE**. Bay region. The seed-cases are fascinating anywhere. Most of you, I am sure, have used them for ear decorations. Have you cut them in two and counted the number of

seeds? Do you know that this kind of a seed-case is called a "samara?"

Study the winter buds and watch the closely coated little leaves unfold. From March you will see the flowering. One of our species, *Acer macrophyllum*, produces perfect flowers on gracefully drooping stems. The other, *Acer Californicum*, has its staminate blossoms on one tree and its pistillate on another. You have perhaps noticed the stamens with the long, slender, pink filaments that let them sway on the breeze.

The name "Acer" is the old title for the family, and means "sharp" or "strong." Why is it called so? "Macrophyllum" is from the Greek meaning "large leaves." You see that the name is appropriate. Its leaves are deeply lobed, while those of *Californicum* are cut into three distinct separate parts. Some people call the *Californicum* the Box Elder, because of its leaves. There is no need to tell you why this Maple is called *Californicum*. That is easy to guess.

A tree whose seed you prefer to that of the

Maple is the Hazelnut. You have searched for it along the streams, usually in the shade of **HAZELNUT**. taller trees. You will find its staminate flowers in drooping catkins and the pistillate ones grouped in a scaly



HAZELNUT.

bud. Look at the bracts, the leaf-like structures, that are at the base of each pistillate blossom. Watch these as the seed grows and see how they increase in size and inclose the



WHITE OAK.

nut. Do you think it easy to destroy this seed-case? This pointed armor of the nut gives the Hazel its botanical names, *Corylus*, which is the Greek for "helmet," and *rostrata*, meaning "beaked." The family name, too, indicates this cup-like covering for the nut. It is *Cupuliferae*, or "cup bearing," which is easy for you to remember. If you think a moment, you will remember that you are well acquainted with some prominent members of the *Cupuliferae*, the Oaks. You know they all have cups to hold their acorns in. Probably most of you have used these same cups at your dolls' parties.

- An Oak that has a deep cup with a rough surface and an inner pale woolly lining is the White Oak. It is the largest and most graceful of its family in California. The Oaks are all called *Quercus* by the botanists.

WHITE OAK. This is from the Celtic and means "a fine tree." The Romans called it that when they first saw the tree hundreds of years ago, but it is just as appropriate to-day. The White Oak's special name is *Lobata* because of its lobed leaves. Its Spanish Californian title,

"Roble," has given a name to one of our towns, "Paso de Robles."

The leaves of the White Oak are always deeply cut into and are gradually narrowed from the top down. They are deciduous, so



YOUNG WHITE OAK

that during some months each year the tree stands with branches nude. Even then it is beautiful, in its gray brown strength.

The catkins of the *Quercus Lobata* appear about February. You will find that they con-

tain only the staminate flowers. If you observe the twigs, you will see other little blossoms topped by three sticky stigmas. With the three stigmas, you would naturally expect to have at least three seeds from each blossom. You know that but one acorn ripens in each cup, so you would better examine into this matter.

If you observe carefully, you will find three cells below the stigmas and then you will see two seeds formed in each of the cells; but just as plants crowd each other out in a garden, so the strongest seed takes all the food and crowds out the other five. Generally you can find some trace of the other seeds and cells in the acorn, either at the top or at the base. In the White Oak, you find them at the bottom.

The acorn of the White Oak ripens the first year. It is from one to three inches long, and usually has a point.

The acorn the Indians preferred was the fruit of the Live Oak of the coast, which is a different species from the Live Oak of the interior valleys and of the Sierra. The coast Live Oak, *Quercus Agrifolia*, ripens its fruit the first season,

LIVE OAKS. while the interior Live Oak, *Quercus Wislizeni*, does not mature its acorns until the second autumn. *Agrifolia* is from the two Latin words meaning "a field" and "leaves." You know "folio" well, and you



LIVE OAK OF COAST (QUERCUS AGRIFOLIA).

have met "agri" in "agriculture." *Wislizeni* is named after Dr. F. A. Wislizenius, who, in early days, gathered some branches of the tree on the American River and sent them to a botanist to be described in science.

Both of these trees get their popular names of

"Live Oaks" from their habit of holding on to the old leaves until the new ones are clothing the branches. *Quercus Agrifolia* throws off its old ones as soon as the spring leaves are well out in March or April, but *Wislizeni* keeps its leaves until the second summer or fall.

The leaves of both the Live Oaks are entire, that is, without lobes, and their margins are wavy and sometimes have teeth on the curves. The leaves of both are beautiful when they first unfold. The *Agrifolia* are tinged with red and have a coat of long white hairs to keep them warm. As the leaves grow older and need less protection, the hairs generally disappear, but sometimes tufts remain in the axils of the principal veins even when the leaves are full grown. You know how leathery these leaves are; how they have a convex curve; and how the upper surface differs from the lower. Have you ever noticed that on the lower surface of some there are little bunches of hairs arranged in the shape of stars? You will find this true of many of the oaks. The young leaves of the *Wislizeni* are dark red, with a fringe of little hairs on the

edge and stellate, or star-shaped, bunches scattered over them. They, too, grow leathery and thick, and their midribs get rounded and raised on the upper surface, while their margins roll back slightly.

Both these Live Oaks blossom early in the spring, when the new leaves are unfolding. The long graceful tassels are formed of the staminate blossoms and the pistillate ones sit on little spikes. The *Agrifolia*, when the insects have injured much of the early foliage, or when there are abundant early rains, sometimes flowers again in the autumn. The acorns from these fall blooms remain on the tree all the winter, tiny things that they are, and with the new burst of life in the spring, enlarge; but they drop to the ground without ripening.

The acorn of *Agrifolia* is long and it narrows abruptly at its base and comes gradually to a point at the top. It is a light chestnut brown and its coat is lined with thick wool. The cup is thin and light brown. Its inner surface is lined with a soft, pale silk, while outside it wears rough, papery scales.

The Wislizeni acorn is long, too, and narrows in the same way; but its brown is often striped longitudinally and its shell has a scanty woolen lining. Its cup is covered with scales that grow thicker at the base and are rounded at the back, and the cup generally extends high up on the fruit.

Another of our Oaks that has a high cup and a striped acorn is the Black Oak, or *Quercus Californica*. This is the largest and most abundant oak of the Sierra Nevada, and it is also found in the valleys of the Coast Range. Its fruit ripens the second year. The acorn is broad and well-rounded and slopes off at the top. In its leaf, the central pair of lobes are the largest, so that the leaf narrows at both top and bottom. The point of each lobe is finished with a bristle-like tooth. The young leaves and their stems are rose color and very hairy. As the leaves grow old, they turn a glossy green, and then soon after the tree casts them off.

The bark of the Black Oak is black and rough. It is sometimes used for tanning, but



TANBARK OAK.

the true "tan-bark oak" of California is *Quercus Densiflora*. This you will find **TANBARK OAK**. a very interesting tree in its flowering. Some catkins bear only staminate blossoms, while others have perfect flowers, those containing both stamens and pistils. Occasionally the other oaks produce perfect flowers, but none so often as does the Densiflora. Then, too, the catkins stand erect instead of drooping. The Densiflora generally blooms in summer so that you find the flowers and the fruit, which takes two years to ripen, on the tree at the same time. The cups are saucer shaped and covered with bristles. The acorns are large and have a thick shell. The leaves are evergreen, oblong, with teeth on their edges, and with large veins.

These are our commonest oaks, and you will find them well worth studying. Each tree seems to differ a little in its method of growth, its leaves, its blossoms, and its fruiting; and there is much that botanists have not yet learned of its habits. Then there are the oak-apple and the mistletoe, both of which you will notice in

studying the oak, and on these alone you can make observations that may in time add your name to the lists of scientists.

If you had been born a little Indian in California two hundred years ago, your favorite nut would not have been the Hazel or the Acorn, but that from the Pine tree. And what fun you

PINES. would have had gathering it! Your father would beat the cones down from the trees and your mother would roast them until the scales opened. Then you all would help take out the nuts and store them away in great baskets for the winter time. You could have eaten as many as you wished while you packed them, for Indian mothers did not make little boys whistle while they worked, as our mammas do when we are picking raisins for the plum-pudding.

To-day many of you get the pine nuts for your pleasure, not for your need, as did the little Indian boys and girls, and you all know that they grow in what we call a cone. You have seen the cones on the trees, but have you noticed the flowers that made the cone?

In the spring-time you have seen the ground or water near the pines all yellow as if a shower of sulphur had fallen. Then you looked up and saw golden tassels waving around on the branches. If you examine these, you find that they consist of stamens alone. The flower that forms the cone is on the same tree, but it is different from any flowers you have known. It has no stigma, but just the little cell waiting uncovered for the pollen to fall upon it and make a seed. Why does the Pine produce so much pollen? What carries it to the seed cell for her? Does she secrete honey? Have you seen any insects feasting in the Pine forests?

You all know the leaves of the Pines as "needles." You have seen that they are attached to the stem in little bundles, with an enclosing sheath around them. Have you noticed that all Pines have not the same number of needles to a bundle, or that all needles are not the same shape? The ground in a Pine forest is always covered with needles. Does the Pine shed them once a year as the Maple

does? Is the tree ever bare? See if you can learn how long the needles do cling to the tree. How are the bundles of needles arranged on the stems? In circles? Is a Pine needle really needle-shaped, without any corners? Has it breathing pores as other leaves have?

In observing the cone, notice if it stands erect with its fruit or hangs pendant. Is it on the end of a branch or on the side? Are the cones single or in pairs or in bunches? Are they opposite on the stem or alternate or in whorls? Do they cling to the tree after the seeds are cast out? If there are hooks on the scales, how do they curve? Why? Are the scales arranged in a circle around the cone or in a spiral? How many scales does it take to reach around the cone once? Soak a cone in water and see what its scales do. You can make a pretty hanging basket by taking advantage of this habit of the Pine cone.

Those of you who have observed the Pines know that their cones differ. The cones of the Sugar Pine, the king of the Pine nation, are

SUGAR PINE. immense and are arranged on long stems near the ends of the branches. When the seeds are ripe, the cone swings off to the ground. The scales are flat and loosely attached and have no hooks. Why do you suppose this is? The seeds are large and edible and have big brown-veined wings to carry them earthward.

Reaching sometimes three hundred feet in height and sixty in circumference, the Sugar Pine's size alone would make it impressive were not the charm of grace and beauty also added. Its tall, erect trunk, unmarred by limb or knot for two-thirds of its height; its rich-toned, checkered bark; its canopy of long, graceful boughs; its slender pendant cones, all awaken such admiration that we can understand how the white man who made it known to the world endangered his life to reach the tree. This was David Douglas, the Scotch botanist. Just here we might say that the boy or girl who cares for California Pines will find the story of Douglas's ramblings, his adventures, and his tragic death exceedingly interesting. He discovered



SUGAR PINE (One-third natural size).

and named six California Pines, and this was but a small portion of his service to our Coast.

Douglas called the Sugar Pine *Pinus Lambertiana* after his friend Lambert, an English botanist. It gets its popular name of Sugar Pine from the sweet gum it exudes after a fire.

A rival to the Sugar Pine is the Yellow Pine or *Pinus ponderosa*. Its trunk, like that of the Sugar Pine, is free from branches to a great height. These large trees are

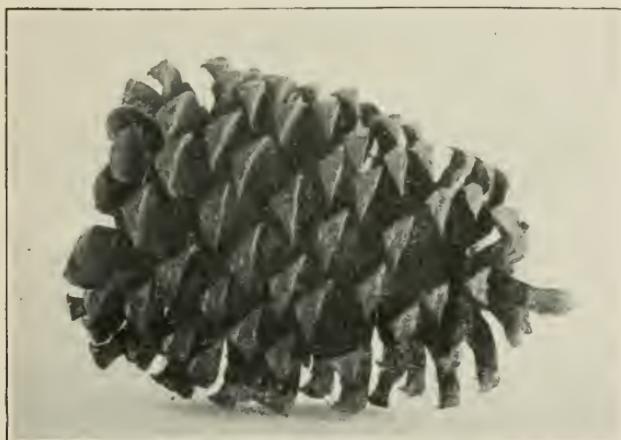
YELLOW PINE. self-pruners, their lower branches withering and dropping off, letting all their strength go to an upward growth. The bark of the Yellow Pine is fissured in great plates, suggestive of alligator leather. Its long needles are in bundles of three and their enclosing sheaths wrap around closely and do not shake off easily. The cones are small and when they break away from the tree they leave behind their stems and some of their lower scales. Did any of you ever find a whole cone of a Yellow Pine on the ground?

The Pine the Indians thought had the best nuts is sometimes called after them the "Digger



YELLOW PINE.

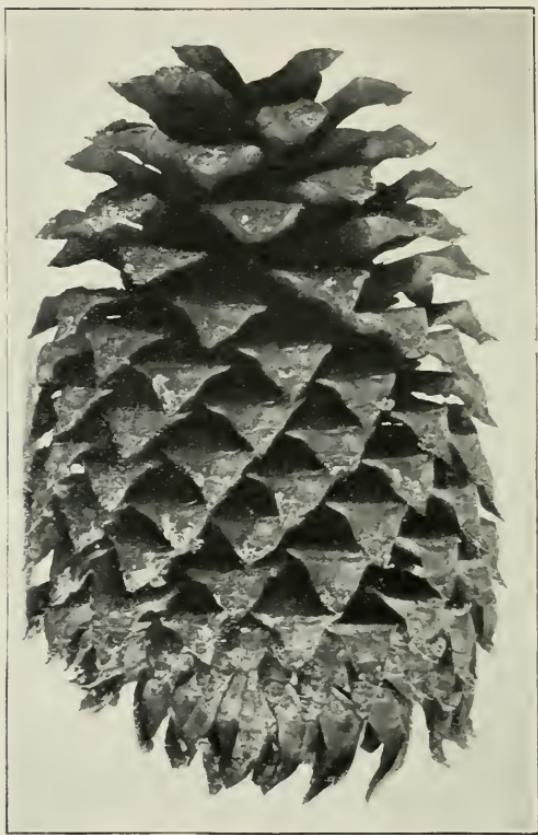
Pine"; sometimes it is named the "Nut Pine," and again the "Gray-leaved **DIGGER PINE.**" This grows so generally throughout the state that most of you know its gray-green foliage, its long, irregular shaggy branches, and its heavy, prickly cones. Some-



YELLOW PINE (Two-fifths natural size).

times its trunk is divided into angular branches. It is never so shapely as the "lumber pines," which, the Indians say, are "eagles' feathers reaching to the sun."

The cones of the Digger Pine grow along the sides of the branch, instead of near its end.



DIGGER PINE (Two-fifths natural size).

The first year, a cone is a globular mass of riches about an inch long, all covered with hooked scales. The second year it increases its length to even ten inches; the scales become heavy and leathery; and the hooks reach from one to three inches. When we remember that under each scale two delicious seeds are ripened, we can tell why the cone has such thick scales and such warlike prickles.

As the seeds mature in the second year, the cones get so heavy that they hang over on their stems. Then, under the late autumn sun, the scales rise up and the dark seeds fly down on their tiny wings to bury themselves in the earth and start new trees the following year. Well for them if the hungry gray squirrel does not spy them, for he relishes the sweet nut as much as does a little boy I know.

When the seeds have scattered, the Digger cone still clings to the tree. After a while the new growth lengthens out its stem and makes it unable to bear the heavy cone. Then the cone falls with a crash to the ground, and if it be not picked up by some enterprising lad, it

finally decays and enriches the soil for its mother tree.

Besides the Digger Pine, which the botanists call *Pinus Sabiniana*, after Joseph Sabine, an English scientist, there are several other nut pines in California. One which was a great favorite with the Indians is the Single-leaf Pine,



1. *PINUS MONOPHYLLA.*
2. *HEMLOCK.* 3. *TAMARACK PINE (PINUS CONTORTA).*
(One-half natural size).

or *Pinus monophylla*, which means the same thing. It is sometimes referred to as "Fremont's Nut Pine," because **SINGLE-LEAF PINE**. General Fremont made careful notes on it in 1845, calling it the "one-leaved pine." From these names you will readily

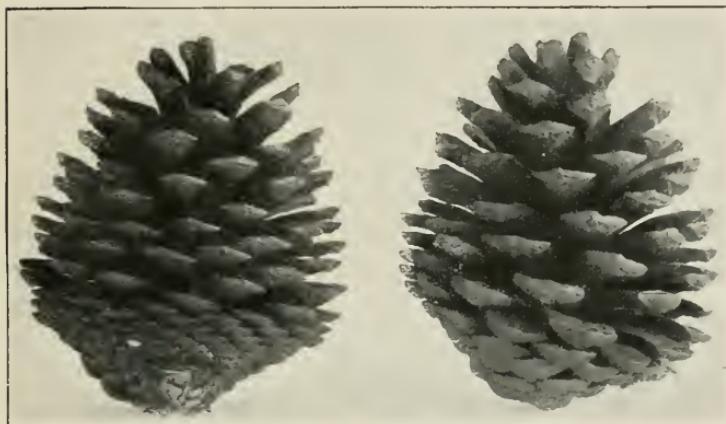
guess that this Pine is peculiar in having but one leaf in each bundle. If you examine each sheath well, you may find a trace of a sister leaf that should have grown up within the same covering. The leaves are so well sharpened that they are highly prized by the elfin dress-makers. The cones are about two inches long and well rounded, with comparatively few scales and these unarmed. The seeds are large, with hard shells and without wings. They are delicious and are so nourishing that the Indians found a handful sufficient food for a day's tramp.

The children of the coast region will probably find the Pine of their vicinity to be the *Pinus Insignis*, or Monterey Pine. It is so called **MONTEREY PINE.** because it was first noted near Monterey Bay. *Insignis* you know the meaning of, from having studied the Baby-blue-eyes. The Monterey Pine branches low down and the limbs are well covered with leaves in bundles of threes. This Pine has an interesting cone growth. The scales near the base have strong knobs, but they do not perfect



TAMARACK PINE (Thin bark).

the seeds beneath. The upper scales are flatter and protect the seeds that ripen. They are most careful guardians, for they do not open when the seeds are mature, but hold them close and safe for an indefinite number of years.



MONTEREY PINE (about one-half natural size).

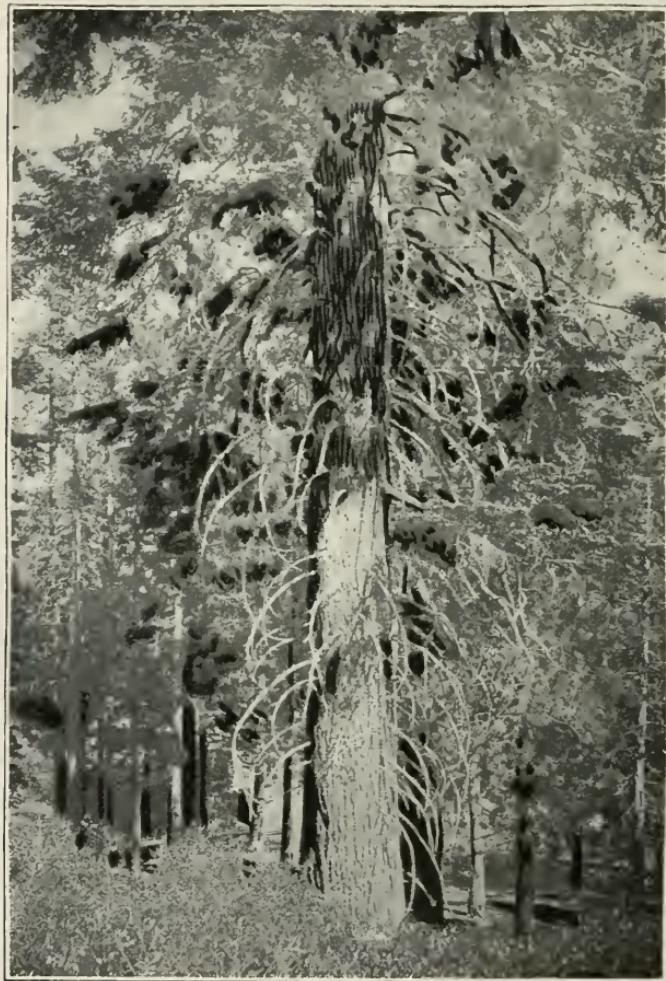
One group of Pines has a thin bark that makes it an easy prey to insects. The prettiest of these is the Tamarack or Lodge-pole Pine.

TAMARACK PINE. You can guess why it is called the Lodge-pole Pine. Its cones are small and drooping, and fall when their seeds are mature. Its needles are in pairs. As it grows old, its branches have a peculiar

way of twisting downward and inward and so limiting their own supply of sap. This habit accounts for the number of dead trees seen in groves of the living. This habit, also, gives the tree its botanical name of *Pinus Contorta*. You know what "contorted" means, and so you can understand why this Pine is named *contorta*.

These are only a few of the Pines in California, and we have noticed only a few points regarding each mentioned. By the cones and the number of needles you can distinguish the different species, but knowing the name of a Pine is only the first step of getting acquainted. A tree is like a person; if you like it at all, the more you know of its habits the more you are interested in it. You can only know a plant by observation. Very few children in our State but have at least one Pine in their neighborhood, either in the woods or in a park, so you all have opportunities to know this mighty tree.

Among the Pine forests of the Sierras, you often see the great Red Fir. Its Latin name, *Abies Magnifica*, shows that it is the most mag-



RED FIR (Showing barks).

FIRS. nificent of the Fir family, called *Abies* by the ancient scholars. Its popular name of Red Fir is given it on account of its rich colored under bark. The covering bark is grayish or brownish, and has deep cracks running up and down.

The Red Fir, and also its sister, the White Fir, which wanders over the Coast Range as well as on the Sierra Nevadas, and the beautiful "Venus" Fir, which hides in the ravines of the Santa Lucia Mountains, are particularly graceful trees. They send their branches out in whorls, the lowest always being the longest, so that the tree tapers up evenly to a point. Then branches come out on either side of the limb, making a horizontal layer of foliage around the tree. As the tree grows old, it cuts off its lower branches, just as the Pines do.

You know that the leaves of the Fir are not in bundles, as are the Pine needles; but have you noticed how they are arranged around the branchlets to make such a thick appearance? See how the ones on the lower side of the twig take a different twist from those on the upper, a-

sort of compound curve? Some of these leaves may be older than some of you who read this, for they cling to the tree for eight or ten years. If you have a microscope, you might see the rows and rows of white-mouthed breathing pores that give the leaf its silvery glisten. These win for a certain Fir the name of "Silver Fir."

The Fir has two kinds of blossoms. The staminate columns fringe the branchlets of the lower limbs of the adult tree with a bright red. The pistillate ones are sitting straight on the upper side of the topmost branches, not more than four to a branch. How do the clouds of yellow pollen reach the seed-cases? Would you not think that the Fir would reverse the position of her flowers and put the staminate ones up top? Why does she place them this way?

The Fir cones are always erect. They have, too, a different habit from the Pine cones. After the winged seeds are cast out, the cone scales peel off, leaving the soft axis remaining upright on the tree. Did you ever pull off

the scale of a Fir cone and find the bract growing on its outer side? In the "Venus" Fir this bract grows longer than the scale and hangs as a long bristle. In our common Firs, it is shorter than the scale and is hidden.

Another of our cone-bearers that has small bracts on the back of its cone scales is the Western Hemlock, or *Tsuga Heterophylla*.

HEMLOCK. *Tsuga* is the Japanese name for the tree, meaning "evergreen." *Heterophylla* is a compound of two Greek words meaning "different" and "leaves." You will find different leaves on the same tree, according to their age and the age of the branches.

The Hemlock cones differ from those of the Fir in being pendant at the end of the branchlet. Then, too, the scales with their bracts remain on the cone after the seeds are scattered. The cones are purplish when they are young, but they turn brown as they ripen. They are very numerous and give a graceful finish to the swaying branchlets.

The Hemlock flowers in early spring. Its staminate blossoms are in clusters, which are

raised out on a little spike when the pollen is mature. The pistillate are hanging on the end of the twigs, where the cones afterwards develop.

The leaves are not spiral on the stem, as in the Fir, but are in ranks of two. Each leaf has a joint near its base; and when withering time comes, the upper part of the leaf twists off, leaving the base on the stem. This leaf base makes a scar on the stem, and the great number of these scars make a roughened surface, which is partly concealed on the younger branches by long hairs.

The main branches of the Hemlock are not in whorls, but alternate, with the upper ones shorter than the lower. The long limbs extend outward and downward in a graceful curve. From either side they have numerous branchlets which divide and subdivide, always in ranks of two, until they end in slender, drooping, hairy little sprays that dance up and down on each passing zephyr.

A tree akin to the Hemlock, and yet very different, is the *Pseudotsuga Douglasii*, or

Douglas Spruce. *Pseudo* is the Greek for "false," so that the name **DOUGLAS SPRUCE.** means "the false Tsuga."

Do you not think it unfair to call so beautiful a tree by such a name? Botanists ought to be able to find titles enough to go around without offering such insults to plants. How would you like to be called "False William," for the reason that you somewhat resemble a man named William? Plants are always working out their own destiny and they do not try to be like anything else, so they cannot be false.

Well, the *Psuedotsuga Douglasii* or Douglas Spruce differs in many ways from the Hemlock. Its cone is noticeable for the long bracts which stick out from behind the scales and curl back in a three-parted extension. The cone is not suspended from the end of the branchlets, but back a little. The branches are not roughened by leaf scars, and the leaves are more numerous than those of the Hemlock. They differ, too, in shape and arrangement. Its bark is thicker and is deeply fissured.

The Douglas Spruce is found in both the



DOUGLAS SPRUCE.

Sierra Nevadas and Coast Range. It is shaped like a pyramid when it has plenty of room to stretch out its arms, or it grows tall and slender if it is crowded. It seems able to adapt itself to any soil or climate, and each year we ship great quantities of its seeds to nurserymen in European countries and their colonies to replant their forests.

By the way, I wonder if any of you know how many dollars a year come to California for the seeds of her native plants. You might learn now to collect seeds carefully, leaving always enough for the plant to reproduce itself on our own soil. We do not wish to sell all our treasures, but only to share our surplus with the world.

One of our conifers whose seeds have been widely scattered by man is the Monterey Cypress. Its original home is a stretch of only two miles on the Monterey coast; and yet since **MONTEREY CYPRESS.** 1838, its seeds have been so distributed that now it is the most widely cultivated cone-bearer of Southern and Western Europe, South America,

and Australia, as well as of our own Pacific Coast. You all have seen it, if not on its native cliffs, where the winds force it into all sorts of odd shapes, at least in some gardens, where it does duty as a hedge.



MONTEREY CYPRESS.

You know its leaves are pressed down closely to its stem, but do you know that they cling on for three or four years? The fruit is in clusters and not like the other cones we have

studied. Cut one open to see just where the seeds ripen and how many there are under each scale.

Botanists call the Monterey Cypress the *Cupressus Macrocarpa*. *Cupressus* is the ancient name for the Cypress, which was found abundantly on the Island of Cypress. *Macrocarpa* means "large fruit."

The leaves of the Cypress are not unlike those of the Juniper, although the habit of growth and the fruit are totally different. Those of you who have seen the Juniper of the **JUNIPER**. Sierra Nevada remember how the trunk often divides into several stems sending up several heads. You know, too, how the bark looks twisted, as if from suffering.

The Juniper leaves you can count in threes, closely bent to the stem. See if you can find little pits on their backs. The fruit, which looks like a berry instead of a cone, was used by the Indians both fresh and to make cakes of. You will notice that while the tree blossoms about January, the fruit does not ripen until the second autumn. Also observe that gener-



JUNIPER.



RED CEDAR.

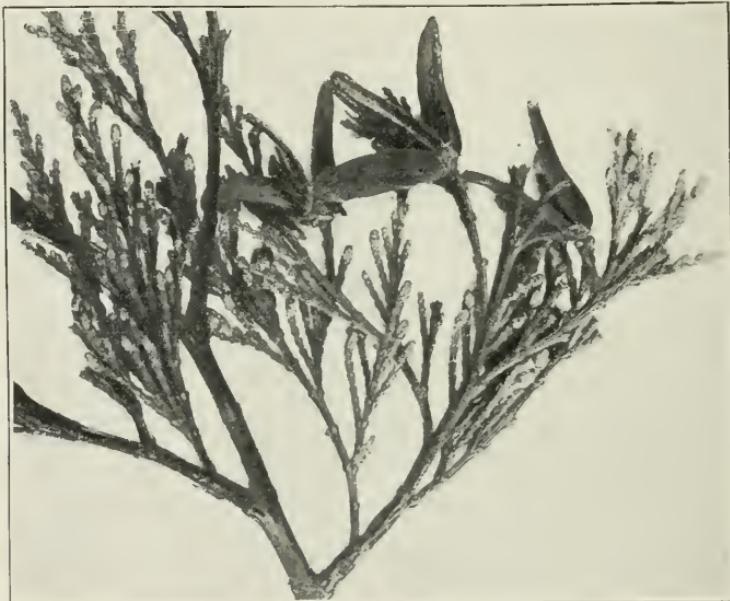
ally the staminate blossoms are on one tree and the pistillate on another.

The botanical name of the Juniper family is *Juniperus*, which is from the Celtic meaning "rough" or "rude." You can see that the name was given because of the bark. In our state we have two native Junipers, *Juniperus Californica* and *Juniperus Occidentalis*. You can tell for yourself what each name means.

Closely allied to the Junipers is a tree that came to us from Oregon. This is the Red Cedar, or *Thuya Gigantea*. *Thuya* is from the Greek word meaning "sacrifice," because the **RED CEDAR**. Cedar was used in burning the offerings to the gods. The leaves of the Red Cedar are somewhat similar to those of the Cypress and the Juniper, but the branches are flattened out, as if they had been ironed. The cones are very small and ripen the first year. Look under the scales and see which ones mature seeds.

We have, too, the Incense Cedar, whose botanical name is *Libocedrus Decurrens*. *Libas* means "fragrant" and *cedrus*, the "Cedar

INCENSE CEDAR. family"; while *decurrens* refers to the way the leaves lie along the stem. Notice how the leaves are arranged, how the tree flowers, how in the cone only the



INCENSE CEDAR (*LIBOCEDRUS DECURRENS*).

middle pair of the six scales ripens seed, how the cone clings on after the seeds are discharged, and these will lead you to observe other things. Then after a while you will feel that you know the tree.



A PROSTRATE GIANT.

1878. 1879.
VANCOUVER ISLAND.

Of all our California trees, the most noted in the outside world is the *Sequoia Gigantea*, or Big Tree. Unfortunately, these are so few that we cannot hope that many of you **BIG TREE.** children are living in their shadow, with the opportunity of studying them at first hand. Some of you have seen them already; and you all will in time, for, of course, you all wish to know the wonders of your own land.

We should know particularly about the Big Tree, because the only place in the whole world where it grows to-day is on the western slopes of the Sierra Nevada, and even here it is not plentiful. There are only about ten groves of the *Sequoia Gigantea*, and these are intermixed with Pine, Fir, Spruce, and Hemlock, all of which, although handsome enough trees by themselves, look dwarfed beside the massive Big Trees.

There is no use of mentioning the height or thickness of the *Sequoia Gigantea*, for if you are like me, the figures will not impress you. Look in your school geography and see the pic-

ture of the class seated on a stump. Then look at your own school-room and see how it compares in size with the stump. Then shut your eyes and let your mind build upon this foundation a great column of rich red-brown that towers to the sky and that, in the upper sunshine, sends out large graceful fans of dark blue green. If your imagination works right, you will see the largest tree in the world; not the tallest, for one other climbs higher, but the mightiest, when all dimensions are measured.

Besides being notable for its size, the Big Tree can claim reverence for its age. It is the oldest living thing now in the world. Some of them have been growing over four thousand years. I cannot think just how long that is, can you? Anyway, it is longer before Christ's birth than our time is since it.

Besides its size and age, the *Sequoia Gigantea* has another claim to being original. It is the rarest of known trees. This is why it is wise for us to preserve the specimens we now have. The United States Government has taken steps to secure some trees to us and our children

forever. As early as 1865, when it gave the Yosemite Valley to California, it gave us also the Mariposa Grove of Big Trees. These belong to the people of our state only, and we have passed laws to take care of them.

In 1890, the United States made two new National Parks in California, just to preserve the Big Trees. These are the General Grant National Park, called after one of the trees which bears the soldier's name, and the Sequoia National Park. These belong to the people of the whole United States. Unfortunately, within these two parks, numerous acres are still owned by private companies, some of whom are lumbering the *Sequoias* off their claims. As the trees are too enormous to handle easily, they are blasted to pieces, and the chunks of soft wood are used for shingles and for grapevine stakes. Just think of murdering a tree, several thousand years old, to hold up a weakling vine! Then all the rubbish scattered over the ground prevents the young trees from growing, and also keeps the parks in constant danger of fire. It is to be hoped



THE WISH-BONE TREE.

that the National Government will soon purchase the private claims and so be able to preserve the trees in its park. And while we are wishing, we might as well hope that Congress will buy up the other groves of *Sequoia*, all of which are now in the hands of private citizens.

The *Sequoia gigantea* is trying hard to continue its species. It flowers profusely in the late winter or early spring. The staminate tassel is so full of pollen that it covers the forest around with gold. The pistillate flower has from twenty-five to forty yellow scales, and under each of these from three to seven seeds are ripened. There are great numbers of cones on each branch, for they are so tiny that each twig can bear a quantity. When the cones are mature, the scales open and the winged seeds fly out. They have a good chance to go sailing, for they have the full force of the wind above the heads of the other trees. It is supposed that only one seed in 10,000 grows into a tree. Such superior trees are delicate in their infancy. Even if they grew easily, we could

not afford to sacrifice the old ones; for we will not be here in three thousand years to see the younger ones in maturity.

The only near relative the *Sequoia gigantea* has is our Redwood, the *Sequoia sempervirens*, also found only in California. These two are the only *Sequoias* in the world. They were named for a Cherokee chief, who, in 1826, invented the Cherokee alphabet. This was used to print a journal for his tribe, called the *Cherokee Phœnix*, and it was also used in a translation of the New Testament. You may be glad that you are not a Cherokee child, for there are eighty-five characters in this alphabet, and probably you have enough trouble with our own twenty-six. However, it takes a great man to invent an alphabet, and we need not feel that our great trees are misnamed. The meaning of *gigantea* you all know, and *sempervirens* means "always green."

The *Sequoia sempervirens* is to me the most beautiful tree we have. You children who live in its belt on the Coast Range, are to be congratulated. On this tree you will find two



REDWOOD.

REDWOOD. kinds of leaves — those on the upper branches like those of *Sequoia gigantea*, which are short and lying close on the stem, and those on the lower branches; which are longer and stand at right angles with the stem, one row on each side. The latter are much the prettier, with their under side covered with a palish bloom. Have you noticed how they take a half turn near the base, so that they can stand out from their stems? Have you looked at them with a microscope? If so, what did you see?

The Redwood flowers in late winter. Watch how its staminate flower is raised on a little stem when it is ready to discharge the pollen. Its pistillate flower usually has about twenty scales, which, as they ripen into the cone, spread themselves out into little disks with deep ridges upon them. Notice how they differ from the cones of the Pine. Under each scale are from three to five seeds. When the seeds are ripe, each has a pair of wings as broad as its body.

Besides reproducing from seed, the Redwood insures new growth by sending out shoots

around every stump. Sometimes, too, it grows anew from fallen branches. This habit of striving to persist makes the Redwood forest the densest growth we have, and under its shade all sorts of plant treasures reward the botanist's search.

After studying these plants that have two kinds of blossoms to make their seeds, you will see that many of the largest and strongest in the vegetable world belong to this class. They may not be so easy to observe as the little plants that creep at your feet, but they are equally interesting.

If we only use our eyes well, we will find that each plant, whether it be herb, shrub, or tree, has its own individual way of doing its life work. Right here in California, where there are so many new plants as yet unstudied, and where the climate allows one to be out of doors all the year round, is a very good place for a boy or girl to plan to become a famous naturalist.

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